

no abs ✓

# THE PHILIPPINE AGRICULTURIST

UNIVERSITY OF THE PHILIPPINES PUBLICATIONS SERIES A

## CONTENTS

Experimental Control of Cogon ( <i>Imperata cylindrica</i> [Linn.] Beauv.), Water Hyacinth ( <i>Eichornia azurea</i> Kunth.), <i>Lantana camara</i> Linn., and Other Noxious Weeds with 2,4-D and Other Herbicides.....	Tauti R. Derico.....	189
Reproductive Capacity of the Common Tomato Lady Beetle .....	Getulio B. Viado.....	202
The Influence of Artificial Illumination on the Egg Production of New Hampshire Yearling Hens.....	Roberto E. Fronda.....	213
Hybridization of Cultivated and Wild Rice.....	José M. Capinpin, and Alfredo B. Magnaye..	219
The Growth and Habits of Kids of Philippine Goats..	Felipe G. Galeon.....	230
Copra Meal in a Ration for Growing Ducklings.....	Adolfo M. Lioanag....	236
The Growth and Activities of Suckling Calves.....	Demetrio M. Cabantac.	240
Organization and Operation of Cooperatives in the Philippines.....	N. B. Tablante, and O. G. Santos.....	243
Published Contributions from the College of Agriculture: XIX.....	L. B. Uichanco.....	252
College and Alumni Notes.....		261

Published by

THE COLLEGE OF AGRICULTURE  
UNIVERSITY OF THE PHILIPPINES

# The Philippine Agriculturist

(University of the Philippines Publications Series A)

---

## Editor

L. B. UICBANCO, SC.D.....*Dean, College of Agriculture*

## Managing Editor

G. O. OCFEMIA, PH.D.....*Professor of Plant Pathology*

## Copy Editors

MEIANIO A. GAPUD, B.S.E.....*Assistant Professor of Agricultural Education*

NELLY DUNGLAO, M.A.....*Instructor In English*

## Business Manager

JOSE M. CAPINPIN, PH.D.....*Associate Professor of Agricultural Botany*

## Advisory Board

R. B. ESPINO, PH.D.....*Head, Department of Agricultural Botany*

F. O. SANTOS, PH.D.....*Head, Department of Agricultural Chemistry*

VALENTE VILLEGAS, PH.D.....*Head, Department of Animal Husbandry*

FRANCISCO M. SACAT, PH.D.....*Head, Department of Agricultural Education*

LEON G. GONZALEZ, PH.D.....*Head, Department of Agronomy*

A. B. CATAMBAY, M.S.....*Head, Department of Agricultural Engineering*

SILVERIO M. CENDAÑA, PH.D.....*Assistant Head, Department of Entomology*

NICOLAS L. GALVEZ, PH.D.....*Acting Head, Department of Soils*

---

Authors of articles appearing in THE PHILIPPINE AGRICULTURIST are severally responsible for the opinions expressed therein.

---

THE PHILIPPINE AGRICULTURIST is published quarterly, beginning with Volume 31, by the College of Agriculture, University of the Philippines, Los Baños, Laguna. The subscription price is ₱6.00 a year in the Philippines and \$4.00 (U.S. currency) elsewhere; the price of single copies, ₱2.00 in the Philippines and \$1.00 (U.S. currency) elsewhere.

Business correspondence should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines. All remittances should be made payable to THE PHILIPPINE AGRICULTURIST.

Communications for the editor should be addressed to the Editor, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

---

Publications sent in exchange for THE PHILIPPINE AGRICULTURIST should be addressed: Library, College of Agriculture, College, Laguna, Philippines.

---

Entered at the Post Office at College, Laguna, Philippines, as second-class mail matter

# EXPERIMENTAL CONTROL OF COGON (*IMPERATA CYLINDRICA* [LINN.] BEAUV.), WATER HYACINTH (*EICHORNIA AZUREA* KUNTH.), LANTANA CAMARA LINN., AND OTHER NOXIOUS WEEDS WITH 2,4-D AND OTHER HERBICIDES<sup>1</sup>

TAUTI R. DERICO

WITH SEVEN TEXT FIGURES

Capinpin and Ocfemia (1949) reported that 49 species of nongraminaceous weeds belonging to 17 families were effectively controlled by a single application of 1,000 p.p.m. aqueous solution of 2,4-D. Ocfemia and Javier (1950) stated that they completely destroyed water hyacinth among rice plants by a single application of 0.1, 0.2, 0.5, and 1.0 per cent aqueous solutions of Esteron 44, 2,4-Dow Powdered Weed Killer, Dow Contact Weed Killer, Dow Selective Weed Killer, and 2,4-Dow Liquid Weed Killer.

Because of the limited work in the Philippines on weed control with chemicals, the experimental control of cogon, water hyacinth, Lantana, and other noxious weeds with 2,4-D and other herbicides was undertaken in the Department of Plant Pathology of the College of Agriculture at Los Baños from May, 1950, to January, 1951. One of the herbicides was also tried for its effectiveness as an economical means of destroying mosaicked abacá plants.

## THE HERBICIDES USED

The following herbicides<sup>2</sup> were used in this work:

(1) 2,4-Dow Weed Killer, (2) Esteron 44, (3) Dow Contact Herbicide, (4) Dow Selective Herbicide, (5) Du Pont 2,4-D 74% Amine Weed Killer, (6) Du Pont Ammate Weed Killer, (7) Du Pont 60% Sodium TCA Weed Killer, (8) Du Pont 2,4-D, and (9) Fernoxone.

## EXPERIMENTS ON COGON AND RESULTS

On April 26, 1950, seven-square-meter plots<sup>3</sup> of young growths of cogon and nongraminaceous weeds were staked off. The plots were spaced sufficiently far apart to prevent the chemicals or concentrations from affecting one another. The experimental plots, each provided with a control, were labeled with the date of treatment and the name and concentration of the chemical used. The aqueous solutions of the herbicides were applied with either a Blizzard Pint-Size Continuous Sprayer or a Hudson Clipper

<sup>1</sup>Experiment Station Contribution No. 1580. From the thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1951. Prepared in the Department of Plant Pathology under the direction of Professor Gerardo O. Ocfemia.

<sup>2</sup>The herbicides were obtained from Getz Bros. and Co., Macondray & Co., Inc., and Warner, Barnes & Co., Ltd. through the generousities of Dr. Ben Mapa; Mr. T. O. Bacon; Mr. N. Sykes, of the Imperial Chemical Industries (China) Ltd., Hongkong, and Mr. S. H. Dann, respectively.

<sup>3</sup>The amount of chemicals available determined the size of the areas staked off.

Sprayer No. 139. The sprayers were washed with water before and after each use. The stages of growth, conditions of flowering, and approximate ages of each species of weeds present in the plots at the time of treatment were recorded.

*Experiment 1.* On June 27, 1950, vigorously growing young cogon plants were sprayed with 1.0, 1.5, 2.0, and 3.0 per cent concentrations of 2,4-Dow Weed Killer, Du Pont 2,4-D, Du Pont 2,4-D 74% Amine, Fernoxone, and Esteron 44. The herbicides were applied at the rate of 1.5 liters to each plot of 7 square meters. Three to seven days after the application, the plants showed yellowing of the foliage, starting either from the tips or margins of the younger leaves. Fernoxone and the different 2,4-D weed-icides produced similar effects. Although concentrations higher than 2.0 per cent injured severely the foliage, they did not kill the weeds. Cogon sprayed with Esteron 44 showed pronounced twisting and burning of the entire aboveground growths; the injury increased with the increase in the concentration of the herbicide.

On July 10, 1950, two weeks after treatment, the cogon almost recovered. Although all the aboveground growths of the cogon treated with 1.5, 2.0, and 3.0 per cent concentrations of Esteron 44 appeared dead, new growths were produced after three to four weeks. The cogon sprayed with the different concentrations of 2,4-D herbicides and with Fernoxone also recovered after two weeks. Cogon sprayed for the second time with the different concentrations of the herbicides gave the same results, indicating that the rootstocks were not killed. Espino (1948) noted that *Imperata cylindrica*, *Oryza sativa*, *Paspalum conjugatum*, and *Zea mays* were not affected by a solution of 2.5 grams of 2,4-D in one liter of water. Harvey and Robbins (1947) found that grasses are generally more resistant to 2,4-D than broad-leaved plants.

*Experiment 2.* On June 27, 1950, other cogon plots were sprayed with 1.0, 1.5, 2.0, and 3.0 per cent solutions of Dow Selective Herbicide and Dow Contact Herbicide. In this test the young leaves and then the older ones began to wilt, droop, and fold in two to three hours. Two days later all the leaves of the treated plants appeared burnt-like. One week after the application the leaves dried up and died.

On July 17, 1950, three weeks after the application of the herbicides, the dried leaves fell but new shoots emerged. When the new growths had two to three leaves each, they were sprayed again, in some cases with increased concentrations. Three weeks after the second spraying, however, a crop of new growths also appeared. An examination of the treated plants showed that the killing action of the herbicides was confined to the aboveground growths as in the case with Esteron 44 in experiment 1. Concentrations of Dow Contact Herbicide and Dow Selective Herbicide lower than 1.0 per cent did not kill the aboveground growths of the cogon. Capinpin and Ocfemia (1948) also noted that some grasses, though seriously injured by 1,000 p.p.m. solutions of 2,4-D, recovered in three to four weeks.

*Experiment 3.* On October 13, 1950, Du Pont Ammate Weed Killer and Du Pont 60% Sodium TCA were sprayed on plots of young cogon plants. In three to four days the plants treated with 4.0, 6.0, 8.0, and 10.0 per cent concentrations of 60% Sodium TCA showed slightly brownish discoloration, drooping, and wilting of the leaves. These injuries gradually

became more pronounced, and in two weeks all the leaves dried up and appeared twisted. By December 30, 1950, the treated cogon plants had sent out a few growths which, however, failed to attain to the size of the untreated plants. For lack of the 60% Sodium TCA herbicide, the treatment could not be repeated.

After three days the cogon plants sprayed with 10.0, 12.0, 14.0, and 16.0 per cent aqueous solutions of Ammate Weed Killer showed yellowing of the leaves, followed by twisting and rolling of the foliage. Two weeks from spraying, all the leaves and stalks turned brown and dried up completely. On November 11, 1950, four weeks after the application of the Ammate solutions, a few abnormal shoots appeared. The leaves were wrinkled, broad, thick, and very short. More of these abnormal plants were observed on the plots sprayed with 10.0 and 12.0 per cent aqueous solutions of Ammate. A few shoots also appeared on the plots sprayed with 14.0 and 16.0 per cent aqueous solutions.

When the sprouts had two to three leaves, the application was repeated. As no sprouts appeared two weeks after the second application, the rootstocks were found to have been killed by the Ammate solutions. The writer noted that the distal ends of the rootstocks were the first to decompose.

*Experiment 4.* To determine whether or not the soil conditions and the stage of cogon growth influenced the herbicidal action of the Ammate Weed Killer, young cogon growths on porous soils were sprayed. The writer noted that a single application of a 14.0 per cent solution at the rate of 4 liters to a seven-square-meter plot readily killed the cogon in two to three weeks (fig. 1). Better results were obtained when the cogon plants were sprayed before they had flowered. Old cogon plants were killed in three to four weeks with the same application.

*Experiment 5.* As Green (1950) obtained good results with TCA applied on a perennial grass after the aboveground growth had been cut off, the writer applied Du Pont 60% Sodium TCA, Ammate, Esteron 44, and the other herbicide solutions on the cogon plants after the tops had been cut off. The treatment, however, did not kill the rootstocks; new growths appeared in two to three weeks after treatment. The few sprouts on the plots sprayed with 60% Sodium TCA and Ammate appeared abnormal. The clipped cogon treated with Fernoxone, Esteron 44, 2,4-Dow Weed Killer, Du Pont 2,4-D, and Du Pont 2,4-D 74% Amine produced new growths which apparently were not affected by the chemicals. Because of the lack of 60% Sodium TCA and Ammate, a second application was not made.

In the treatment of cogon, it was found that a single application of 14.0, 16.0, and 18.0 per cent aqueous solutions of Ammate at the rate of four liters to every seven square meters (616.92 gallons to an acre) killed after three weeks the cogon plants growing on porous soil. Cogon on heavy compact soil required a second application of the same solution. Ammate was more effective when used as a foliage spray on young growths of cogon than when applied on old plants after the aboveground parts had been cut off.

Sodium TCA in 4.0, 6.0, 8.0, and 10.0 per cent aqueous solutions killed in two weeks the aboveground parts of cogon but not the rhizomes. The

new growths, however, were markedly stunted and were unable to attain normal growth.

Esteron 44 in 1.5, 2.0, and 3.0 per cent aqueous solutions killed the aboveground parts of cogon but did not prevent the emergence of new growths.

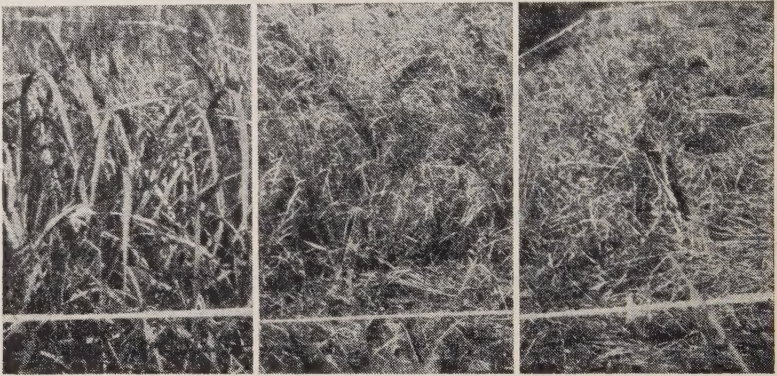


Fig. 1.—Left, the cogon plants on friable soil before they were treated with a 14.0 per cent aqueous solution of Ammate Weed Killer. Center, the same plants two weeks after treatment, showing the bending, twisting, and death of the aboveground parts. Right, the same plants six weeks after they had been sprayed. The plants were killed to the rhizomes.

Fernoxone, 2,4-D Weed Killer, Du Pont 2,4-D 74% Amine, and Du Pont 2,4-D in 1.0, 1.5, 2.0, and 3.0 per cent aqueous solutions killed only some parts of the cogon leaves. The plants recovered in two to three weeks.

#### EXPERIMENTS ON WATER HYACINTHS AND RESULTS

A mass of thickly packed water hyacinths, 25 to 35 centimeters tall, growing along the shore of Laguna de Bay at Mayondon, Los Baños, was selected for this study. Five-square-meter plots spaced sufficiently far apart were staked off and fenced with bamboo slats to hold the water hyacinths in place and to prevent the mixing of the treated with the untreated plants. The plots, each provided with a control, were labeled with the date of treatment and the name and concentration of the herbicide used. The kinds and comparative abundance of animal life in the water were observed and recorded before the solutions were applied on the hyacinths. Some of the water hyacinths had already flowered, although a large number were still in their prebudding and seedling stages.

*Experiment 1.* On November 6, 1950, the thick mass of water hyacinths was thoroughly sprayed with 0.25, 0.5, 1.0, and 1.5 per cent aqueous solutions of 2,4-Dow Weed Killer (fig. 2), Du Pont 2,4-D 74% Amine, Du Pont 2,4-D, Fernoxone, and Esteron 44 (fig. 3) at the rate of one liter to a plot of five square meters. Three days after, the flowers that were open at the time of the treatment withered, and the buds drooped and failed to open. The leaves became epinastic, and brown patches appeared on the

float bulbs. The extent of the injuries resulting from the application of the herbicide was directly proportional to the strength of the spray solutions. The effects of Esteron 44 were more severe than those of the other weed killers. A great number of the float bulbs appeared scalded, and the flower stalks drooped. At the end of the first week partial drying, twisting, and

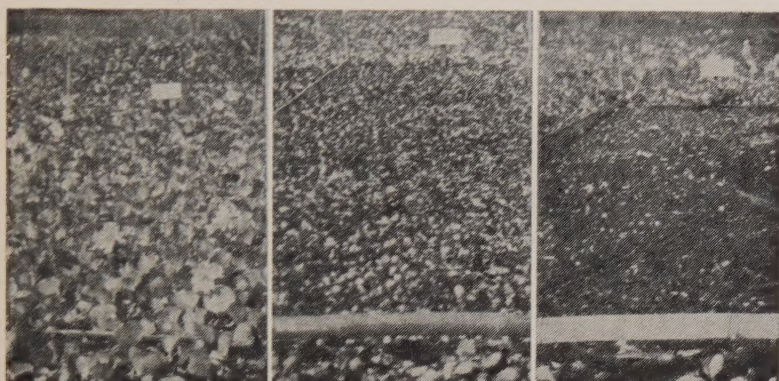


Fig. 2.—Left, the water hyacinths before they were treated with a 0.5 per cent aqueous solution of 2,4-Dow Weed Killer. Center, the same plants two weeks after treatment, showing the dead above-water parts. Right, the same plants, showing the dead plants four weeks after treatment.

curling of the top growths were noted in all the treated water hyacinths. Two weeks after treatment the majority of the plants sprayed with 1.0 and 1.5 per cent Fernoxone, Esteron 44, Du Pont 2,4-D, Du Pont 2,4-D 74% Amine, and 2,4-Dow Weed Killer were killed; only a few plants remained green. At the end of four weeks all of the water hyacinths sprayed with 0.5, 1.0, and 1.5 per cent solutions of the chemicals were killed. A few plants treated with 0.25 per cent solutions of the herbicides survived, but they were stunted and partially deteriorated.

The water hyacinths around the treated plots, within a radius of one meter, were killed in four to six weeks by the mist of the solutions of Fernoxone, Esteron 44, 2,4-Dow Weed Killer, Du Pont 2,4-D, and Du Pont 2,4-D 74% Amine. Some of the plants which survived were stunted.

*Experiment 2.* On November 6, 1950, other masses of water hyacinths were treated with 0.5, 1.0, 1.5, and 2.0 per cent solutions of the Dow Contact and Dow Selective herbicides. Four hours after spraying, burning of the tips of the leaves and wilting of the flowers were noted. The injuries became more pronounced on the third day. Subsequent wilting, twisting, curling, and drying of the above-water parts followed. After the first week, most of the above-water growths turned brown and dried up; the least affected ones flowered. Two weeks after treatment a few of the plants sprayed with 1.5 and 2.0 per cent aqueous solutions died, but many of the apparently dead hyacinths set out new growths. Only a small number of plants were killed in the plots treated with the 0.5 and 1.0 per cent solutions.

*Experiment 3.* On November 19, 1950, two weeks after the first application of the Dow Contact and Dow Selective herbicides in experiment 2, the same plants were resprayed with the same herbicides. Four weeks after treatment the majority of the sprayed plants produced new growths (fig. 4). In some cases, 5.0 or 6.0 per cent solutions of the herbicides were

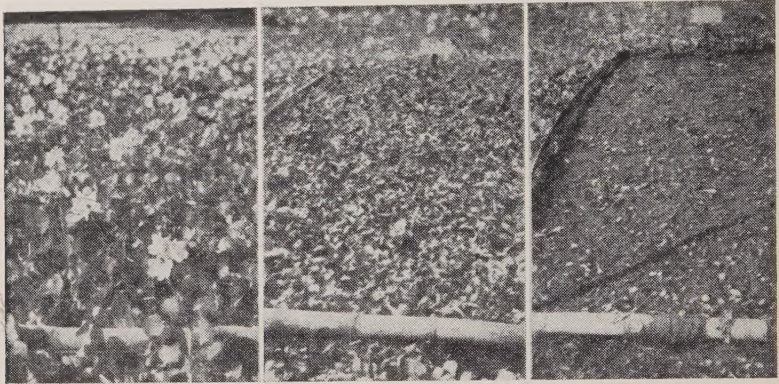


Fig. 3.—The effects of Du Pont 2,4-D 74% Amine on mature hyacinths. Left, the plants before treatment with a 0.5 per cent concentration of the herbicide. Center, the same plants two weeks after treatment, showing partial death of the treated plants. Right, the same plants four weeks after spraying. Some of the dead plants had settled to the bottom.

used in the second spraying. Even with these higher concentrations, however, the water hyacinths were not completely destroyed; new growths began to appear after three weeks. This observation does not agree with that reported by Ocfemia and Javier (1950) that water hyacinths growing among rice stools in the paddies were killed by a single application of the Dow Contact and Dow Selective herbicides at concentrations ranging from 0.1 to 1.0 per cent. These workers recommended, however, that for better results repeated sprayings should be made.

*Experiment 4.* Plots with thick growths of water hyacinths were treated with 1.0, 2.0, 4.0 and 6.0 per cent concentrations of Sodium TCA (fig. 5) and 4.0, 6.0, 8.0, and 10.0 per cent concentrations of Ammate Weed Killer (fig. 6). At the end of the first week most of the leaves of the treated plants were killed; the solutions, however, did not prevent the plants from flowering. By the end of the second week new growths had appeared. Although the top portions of the plants were very seriously injured, only a few of the plants died in three weeks. The new shoots produced by the plants treated with Ammate grew rapidly. Even after another application of higher concentrations of the spray, only an insignificant proportion of the water hyacinths was killed. The writer noted burned spots on the foliage of the plants which had received the mist of the solutions of Dow Contact Herbicide, Dow Selective Herbicide, Ammate Weed Killer, and 60% Sodium TCA.

As regards the effect of the sprays on the animal<sup>4</sup> life in the water, it was noted that the shrimps (*Atya* sp.), fingerling fishes (*Ophiocara aporos* Bleeker), corixid bugs, and small fresh-water snails (*Ampullaria luzonica* Reeve) among the roots of the water hyacinths were apparently not affected by the chemical solutions. This observation corroborates that of Hildebrand



Fig. 4.—The effects of 0.5 per cent aqueous solution of Du Pont 2,4-D on water hyacinths. Left, the plants before treatment. Center, the same plants two weeks after treatment with a 0.5 per cent solution of the herbicide. Note the dead above-water parts. Right, the same plants four weeks later. Some of the dead mass had sunk to the bottom.

(1946) who reported that 2,4-D has no injurious effects on water life because it is a growth substance for plants and operates on the "hormone" principle. Vass (1951) found that 2,4-D, in concentrations used in practical application, does not have any harmful effect on fish and other fresh-water life.

The water hyacinths treated with higher concentrations of Dow Contact Herbicide, Dow Selective Herbicide, Ammate Weed Killer, and 60% Sodium TCA continuously produced new growths which replaced the parts killed by the sprays. The water hyacinths treated with Fernoxone, Esteron 44, Du Pont 2,4-D, 2,4-Dow Weed Killer, and Du Pont 2,4-D 74% Amine did not flower; on the other hand, those sprayed with Dow Contact, Dow Selective, 60% Sodium TCA, and Ammate Weed Killer flowered in one to two weeks. This observation corroborates the report of Hitchcock, Zimmerman, Kirkpatrick, and Earle (1949) that all of these toxicants (nonhormone herbicides) were less effective or ineffective for killing hyacinths when used at the approximate minimum effective dose of 2,4-D. The same authors stated that non-hormone toxicants which killed or severely injured the foliage of hyacinths failed to prevent the development and opening of flower buds, as did effective doses of 2,4-D. In this study, the herbicides which killed water hyacinths—2,4-Dow Weed Killer, Du Pont 2,4-D, Du Pont 24-D 74 % Amine, Fernoxone, and Esteron 44—all contain 2,4-dichlorophenoxyacetic acid as the active ingredient.

<sup>4</sup>Identification by Dr. Silverio M. Cendaña of the Department of Entomology.

In the treatment of water hyacinths it was found that 0.5, 1.0, and 1.5 per cent aqueous solutions of Fernoxone, Esteron 44, 2,4-Dow Weed Killer, Du Pont 2,4-D 74% Amine, and Du Pont 2,4-D were the most effective. They killed the water hyacinths in three to four weeks. Concentrations lower than 0.5 per cent did not kill 100 per cent of the plants,

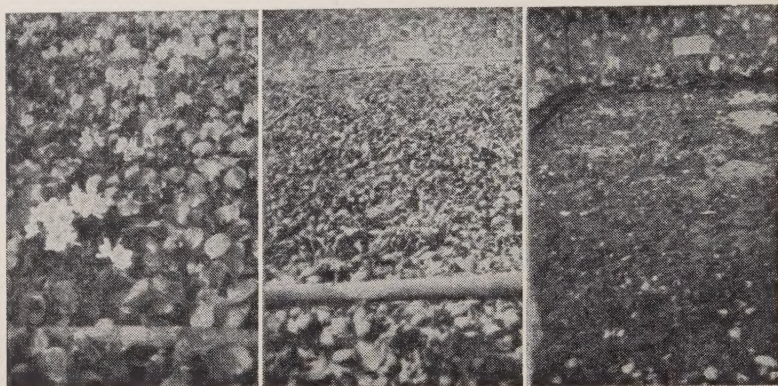


Fig. 5.—Left, the plot of water hyacinths before it was treated with 0.5 per cent aqueous solution of Fernoxone. Center, the same plot after two weeks. Some parts of the treated plants had died. Right, the same plot four weeks after treatment. A large number of the dead plants had settled to the bottom.

although they completely checked flower production. The plants which survived the first treatment with 0.25 per cent solution were stunted and were killed by a second application of the herbicides. Water hyacinths within one meter of the treated plots were either killed or injured seriously.

Even at concentrations as high as 5 and 6 per cent, Dow Contact Herbicide, Dow Selective Herbicide, 60% Sodium TCA, and Ammate Weed Killer were not effective against water hyacinths. New growths emerged in three weeks. The herbicides did not affect the water hyacinths which were not sprayed directly.

The herbicides did not show any toxic effect on the shrimps (*Atya* sp.), fingerling fishes (*Ophiocara aporos* Bleeker), corixid bugs, and small freshwater shells (*Ampullaria luzonica* Reeve) among the water hyacinths.

#### EXPERIMENTS ON LANTANA AND OTHER NOXIOUS WEEDS IN THE PASTURE AND RESULTS

The herbicide treatment for the control of *Lantana camara* Linn. was carried out in the Animal Husbandry pasture of the College. The other noxious weeds included in the treatment were "payang payang" (*Maghania strobilifera* [Linn.] St. Hil.), "sambong" (*Blumea balsamifera* [Linn.] CD.) and *Urena lobata* Linn. The herbicides 2,4-Dow Killer, Esteron 44, Ammate Weed Killer, and Fernoxone in concentrations of 1.0 to 8.0 per cent were used. Capinpin and Ocfemia (1948) reported that lantana seedlings

were easily killed by 2,4-D, and Javier<sup>5</sup> (1949) found that lantana can be controlled with aqueous solutions of Esteron 44 in concentrations ranging from 1,000 p.p.m. to 10,000 p.p.m.

Three days after the application of the herbicides, the leaves of the lantana plants treated with 1.5 per cent solution of 2,4-Dow Weed Killer,



Fig. 6.—Left, the water hyacinths before treatment with 0.5 per cent aqueous solutions of Esteron 44. Center, the same plants two weeks after treatment. Most of the plants were killed by the application. Right, the same plants four weeks after spraying. Many of the dead plants had sunk.

Esteron 44, and Fernoxone drooped and wilted. The plants treated with 1.0 per cent solution showed the same effects five days after treatment. Drying of the flowers, darkening of parts of the leaves, and bending of the younger portions of the branches followed. These injuries became more pronounced after the first week. The leaves dried up, assumed a dark-brown appearance, and started to fall off. All the flowers and the majority of the fruits dropped off after one week. Two weeks later, all the lantana plants were completely defoliated, and the few fruits that persisted on the stems dried up. Most of the treated lantana showed cracking of the bark, which became dark and sloughed off easily when pressed (fig. 7). The 1.0 and 1.5 per cent solutions of Esteron 44 and Fernoxone killed the plants to the roots in two weeks. New growths from the living parts of the stems of the plants treated with 1.0, 1.5, and 2.0 per cent solutions of 2,4-Dow Weed Killer were produced after two weeks. Grigsby (1946) found that applications of 1,000 p.p.m. of 2,4-D generally killed the leaves and young stems of poison ivy, but the lower portions of the stems usually remained alive. In the present study the writer noted that, although 4.0, 6.0, and 8.0 per cent solutions of Ammate Weed Killer killed the foliage and the younger portions of the stems of lantana in four days, the lower portions of the stems survived and produced new growths after two weeks.

In four weeks, *Blumea balsamifera*, *Maghanian strobilifera*, and *Urena lobata* were killed by applications of 1.0 to 2.5 per cent solutions of 2,4-Dow

<sup>5</sup>JAVIER, SILVESTRE V. A further study of weed eradication with 2,4-D and other herbicides. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, 1949. Unpublished.)

Weed Killer, Fernoxone, and Esteron 44. However, some of the *Urena lobata* treated with 2,4-Dow Weed Killer survived and produced rosette-like sprouts after three weeks. Felber (1948) noted that when the terminal growths of bean plants are inhibited by 2,4-D, abundant, abnormal, and even cotyledonary shoots are produced. Grigsby (1946) found that 2,4-D



Fig. 7.—Left, *Lantana camara* two weeks after treatment with a 1.0 per cent aqueous solution of Esteron 44, showing the dead plants and the bent soft portions of the dead stems. Center, *lantana* plants completely killed two weeks after they had been sprayed with a 1.0 per cent solution of Fernoxone. The cogon plants at the base of the treated *lantana* plants were not affected by the chemical. Right, mosaicked abacá plant three weeks after treatment with a 2.0 per cent aqueous solution of 2,4-Dow Weed Killer, showing dead stool and decayed stalks.

does not give satisfactory results on poison sumac and on almost all other woody shrubs. The nongraminaceous weeds (*Elephantopus scaber* Linn. and *E. spicatus* Aubl.) in the lawns of the Plant Pathology Building were killed by 0.5 to 1.0 per aqueous solutions of 2,4-Dow Weed Killer, Fernoxone, and Esteron 44. The writer concludes that *Lantana camara* may be killed by a single application of 1.0, 1.5, and 2.5 per cent aqueous solutions of Esteron 44 and Fernoxone in two to three weeks. Likewise “payang-payang” (*Maghania strobilifera*) and *Blumea balsamifera* were destroyed by similar applications of these herbicides.

According to Eames (1949) 2,4-D in tributylphosphate and kerosene, applied in concentrations of 3,000 p.p.m., killed nut grass (*Cyperus rotundus* Linn.) in about one day; butyl 2,4-dichlorophenoxyacetate and butyl 2,4,5-trichlorophenoxyacetate in two treatments killed most of the plants in about two weeks. Capinpin and Ocfemia (1948) stated that they killed *Cyperus rotundus* with one application of 1000 p.p.m. of 2,4-D. In the present study *Cyperus rotundus* was treated with 1.0, 2.0, 3.0, and 4.0 per cent solutions of Fernoxone. It was observed that 2.0 to 3.0 per cent aqueous solutions applied at the rate of two liters to every five square meters killed the plants to the corm in two to three weeks. The foliage yellowed, darkened, and became brittle and easily detached from the corm. Only a few plants in the lots treated with 1.0 per cent solution sent out new growths.

When 0.5, 1.0, 1.5, and 2.0 per cent solutions of Fernoxone were applied on mixed growths of grasses and broad-leaved weeds present in the vacant lots on the College campus, the nongraminaceous weeds were the first to exhibit the deleterious effects. The younger plants were killed in four days, and the older ones in three to four weeks. The 0.5, 1.0, 1.5 and 2.0 per cent aqueous solutions of Fernoxone showed the same range of killing effect as the 2,4-D used by Capinpin and Ocfemia (1948).

Lou, Yen, and Hsueh (1950) stated that cereals are more tolerant to the effects of 2,4-D than broad-leaved plants. In the present study *Andropogon aciculatus* Linn. (amor seco), *Saccharum spontaneum* Linn. (talahib), *Cynodon dactylon* (Linn.) Pers. (kawad-kawad), and *Rottboellia exaltata* Linn. (aguiñgay) were resistant to 0.5, 1.0, 1.5, and 2.0 per cent aqueous solutions of Fernoxone.

#### TREATMENT OF MOSAICKED ABACÁ PLANTS

The control of abacá mosaic calls for the destruction of the diseased plants. However, the cost of labor involved in eradication by means of uprooting and burning diseased stools is high. In New South Wales, Australia, Jeater, Cann, and Eastwood (1951) reported the use of hormones for destroying bananas. Because of the insufficient number of good-sized diseased abacá plants, the writer limited his trial to only one of the herbicides.

*Experiment 1.* On August 21, 1950, mosaicked abacá plants growing behind the Plant Pathology Building were topped 30 centimeters above the ground. The cut surfaces of the pseudostems of the stools were treated with 1.0, 1.5, and 2.0 per cent aqueous solutions of 2,4-Dow Weed Killer. Each stool had two to three stalks at the time of treatment. Only one concentration was applied to every two stools. One stool was used as control.

Three to four days after spraying, the heart of the treated stalks produced growths about eight centimeters long. The growths gradually changed in color from white or pale green to water-soaked brown and died after one week. On September 3, 1950, two weeks after the application of the spray solutions, two suckers emerged from one of the stools treated with the 1.0 per cent solution. None appeared from the stools treated with the 2.0 per cent solution. One of the stools treated with the 1.0 per cent solution died perhaps because of the weakened condition of the diseased plant. The central cylinders of the treated stalks rotted. The outer parts of the pseudostems remained green until the third week.

On September 10, 1950, twenty-one days after treatment, the corms of the stools treated with the 2.0 per cent solution were dug up. The corms, about 30 centimeters in diameter, and their suckers were dead (fig. 7). The interior tissues of the corms, starting from the bases of the pseudostems, were brown and rotten.

On November 7, 1950, eleven weeks after treatment, the suckers which emerged from the corms of the stools sprayed with the 1.0 and 1.5 per cent solutions did not show signs of injury, although the butts of the cut pseudostems were dead and decomposed.

*Experiment 2.* On November 14, 1950, the new suckers of the three living stools in experiment 1 were cut off for use in the test. The result showed that two per cent aqueous solution of 2,4-Dow Weed Killer applied on the cut surfaces of mosaicked abacá stalks which had been cut 30 centimeters above the ground killed the plants completely three weeks after treatment.

## SUMMARY

1. At the rate of four liters to every seven square meters of land, single applications of 14, 16, and 18 per cent aqueous solutions of Ammate Weed Killer killed the cogon plants growing on porous soil. This herbicide was more effective when used as a foliage spray on young growths of cogon than when applied on old plants after the aboveground parts had been cut off.

2. The 0.5, 1.0 and 1.5 per cent aqueous solutions of Fernoxone, Esteron 44, 2,4-Dow Weed Killer, Du Pont 2,4-D 74% Amine, and Du Pont 2,4-D, all containing 2,4-dichlorophenoxyacetic acid as the active ingredient, were the most effective for killing water hyacinths in three to four weeks. These herbicides had no deleterious effects on the fauna in the water where the hyacinths were growing.

3. *Lantana camara* Linn. was killed by a single application of 1.0, 1.5 and 2.5 per cent aqueous solutions of Esteron 44 and Fernoxone in two to three weeks. *Maghanian strobilifera* [Linn.] St. Hil. and *Blumea balsamifera* (Linn.) DC. were also destroyed by similar applications of these two herbicides.

4. A two per cent aqueous solution of 2,4-Dow Weed Killer applied on the cut surfaces of mosaicked abacá stalks which had been cut 30 centimeters above the ground killed the plants completely.

## LITERATURE CITED

- CAPINPIN, R. I., AND G. O. OCFEMIA. 1948. A study of weed eradication with 2,4-D in lawns, vacant lots, and pastures. *Philippine Agriculturist* **31**: 239-255. *Fig. 1-3*.
- EAMES, A. J. 1949. Comparative effects of spray treatments with growth-regulating substances on nut grass, *Cyperus rotundus* L., and anatomical modification following treatment with butyl 2,4-dichlorophenoxyacetate. *Amer. Jour. Bot.* **36**: 571-584 *Fig. 1-33*.
- ESPINO, R. B. 1948. Effect of 2,4-D on some common plants. *Philippine Agriculturist* **32**: 60-64.
- FELBER, I. M. 1948. The formation of protuberances on bean leaves in response to 2,4-D treatment. *Amer. Jour. Bot.* **35**: 555-558. *Fig. 1-3*.
- GREEN, K. R. 1950. T.C.A. a promising new weedicide for grass control. *Agric. Gaz. New South Wales.* **61**: 455-456.
- GRIGSBY, B. H. 1946. Some effects of 2,4-D on ragweed and certain woody plants. *Michigan Agric. Exper. Sta. Quart. Bull.* **28**: 304-310. *Fig. 1*.
- HARVEY, W. A., AND W. W. ROBBINS. 1947. 2,4-D as weed killer. *Calif. Agric. Ext. Serv. Cir.* **133**: 1-12. *Fig. 1*.
- HILDEBRAND, E. M. 1946. Herbicidal action of 2,4-dichlorophenoxyacetic acid on water hyacinths, *Eichornia crassipes*. *Science* **103**: 477-479.
- HITCHCOCK, A. E., P. W. ZIMMERMAN, H. KIRKPATRICK, JR., AND T. T. EARLE. 1949. Water hyacinth: its growth, reproduction, and practical control by 2,4-D. *Contrib. Boyce Thompson Inst.* **15**: 363-401. *Fig. 1-9*.

- JEATER, J. G., H. J. CANN, AND H. W. EASTWOOD. 1951. Hormones used to destroy bananas. *Agric. Gaz. New South Wales* **62**: 77-81.
- LOU, C. H., I. F. YEN, AND Y. L. HSUEH. 1950. 2,4-D seed treatment and its effect on subsequent growth of germinating seeds. *Chinese Jour. Exper. Biol* **3**: 41-54.
- OCFEMIA, G. O., AND SILVESTRE V. JAVIER, JR. 1950. Experimental control of water hyacinth in lowland rice fields with herbicides. *Philippine Agriculturist* **33**: 285-286. *Fig. 1*.
- VAA8, K. F. 1951. Notes on the water hyacinth in Indonesia and its eradication by spraying with 2,4-D. *Contrib. Gen. Agric. Res. Sta. Bogor, Indonesia* **120**: 1-54. *Fig. 1-6*.

# REPRODUCTIVE CAPACITY OF THE TOMATO LADY BEETLE<sup>1</sup>

GETULIO B. VIADO<sup>2</sup>

*Of the Department of Entomology*

WITH ONE PLATE

In the Philippines the tomato lady beetle, *Epilachna philippinensis* Dieke<sup>3</sup>, is one of the most important pests of solanaceous plants, particularly tomato. Both the larva and the adult feed voraciously on the leaves of the hosts. When they become numerous they often defoliate the host. There were instances when the adults were observed to be feeding even on the young fruits, green tender shoots, and soft petioles of tomatoes in the absence of the leaves. Stanton (1903) found that the worst insect pest of the tomato plant in the neighborhood of Manila in 1902 was *Epilachna philippinensis*, which had been confused with the Australian *E. vigintioctopunctata* Fabr. until Dieke (1947) reworked the genus *Epilachna*. Stanton reports that when the plants are badly infested with larvae, the outer surface of even the larger stems is rasped away and the whole plant withers. Uichanco (1915) states that there were times when the insect was present in great numbers, skeletonizing the leaves and chewing off the bark of the stem till the plant finally succumbed to their depredations. He further states that plants from two to three weeks in the field were found to be most susceptible to the attacks of this insect.

Of cultivated plants, the tomato and the eggplant are the most favored hosts of the insect, at least in the College of Agriculture, Los Baños, Laguna, Philippines.

The present study was started several years ago. The object was to study the nature of the ovarian contents and the reproductive capacity of the common tomato lady beetle. Observations were conducted both in the field and in the laboratory, but most of the work was performed in the laboratory of the Department of Entomology of the College.

## MATERIALS AND METHODS

Larvae and pupae were collected from tomato plants in the field of the College of Agriculture and were placed separately in individual rearing containers. A day after emergence, female adults were dissected for study. Some of the newly emerged adults were confined in separate cages for observation.

In gathering data on reproduction, the newly emerged adults were confined in separate battery jars of clear glass 15 cm. in diameter and 20 cm. tall and cylindrical screen cages 12 cm. in diameter and 20 cm. tall, one pair to a container. Tomato leaves were used as feed. Dead males

<sup>1</sup>Experiment Station Contribution No. 1581.

<sup>2</sup>The author wishes to acknowledge his indebtedness to Dean L. B. Uichanco for valuable suggestions.

<sup>3</sup>Identified by Dr. E. A. Chapin, of the United States National Museum.

were replaced during the period of study. The containers were examined twice daily, in the morning and in the afternoon. The feed was changed every morning.

To determine the general position and nature of the reproductive system of the female adults, dissections were made on both fresh and alcohol-fixed specimens, and drawings were made with the aid of a camera lucida.

One-day-old females were dissected, and the ovaries were examined individually. The number of oöcytes in five germariums taken at random from one ovary or a total of ten germariums to one female, were counted, after which each of the ten germariums was measured. This examination was conducted with the aid of a compound microscope. The use of Schneider's aceto-carmin facilitated the counting of the oöcytes. The width of the germarium was taken approximately midway from the base to the end with an ocular micrometer. The number of ovarioles or ovarian tubes to each ovary was then counted with the aid of fine dissecting needles and a binocular microscope. To avoid mistakes in counting, each ovariole was detached from the ovary. Adult females of various ages were also dissected and their ovaries examined.

The specimens used in the study of the ovarian contents of spent<sup>4</sup> adults were taken from both individual and mass cultures. The females from the mass cultures were 60 days old; those from the individual cultures ranged in age from 30 to 65 days. The specimens used in the oöcyte counts and measurements of the germarium of spent females were from the mass cultures.

#### DISCUSSION OF RESULTS

##### *Ovariole counts*

Counts on the number of ovarioles in one-day-old females (table 1) showed no appreciable difference from those on spent females (table 2). In both tables, however, it is evident that the number of ovarioles in each ovary is variable. In one-day-old females, the highest number of ovarioles in the right ovary, based on 272 individuals, was 42 and the lowest, 22, or an average of  $34.3 \pm 0.16$ . In the left ovary the number ranged from 19 to 41, or an average of  $34.1 \pm 0.19$ . The highest total number of ovarioles to an individual was 82 and the lowest, 46.

In spent females the highest number of ovarioles in the right ovary was 40, based on 88 individuals, and the lowest, 24, or an average of  $34.8 \pm 0.41$ . The figures corresponding to those of the left ovary were 40, 21, and  $34.2 \pm 0.49$ . The highest total number of ovarioles to an individual was 80 and the lowest, 46.

In both one-day-old and spent females the total number of ovarioles to an average female was 68.

##### *Number of oöcytes to an ovariole*

The number of oöcytes to an ovariole was taken to mean the number of visible cells in the germarium, when Schneider's aceto-carmin was used,

<sup>4</sup> The term "spent" as used in this paper refers to females 60 days old or older which have laid practically all their quota of eggs.

multiplied by two. The factor "two" takes care of the number of oöcytes visible at the opposite side of the germarium examined. It is very likely that the figures obtained were lower than the actual number of oöcytes because of the thickness of the germarium which made it impossible to count those at the center of the germarium.

In one-day-old females the maximum number of oöcytes to an ovariole, based on 51 females or a total of 510 ovarioles, was 534. The minimum was 248 and the average,  $376.8 \pm 1.54$ . There was no marked difference between the germarium contents of the one-day-old females and that of females at about the close of the period of fecundity. In spent females the maximum, based on 23 individuals or a total of 230 ovarioles, was 402 and the minimum, 282. The average was  $350.6 \pm 2.68$ .

Based on the average number of 376.8 oöcytes and 68 ovarioles in the one-day-old female, the total number of potential eggs to the individual was 25,622. In the spent female the number of potential eggs was 23,841.

#### *Size of germarium*

The longest germarium in the one-day-old females examined measured 0.64 mm. and the shortest, 0.39 mm. The average was  $0.53 \pm 0.00$  mm.. The figures corresponding to the width were 0.24, 0.14, and  $0.18 \pm 0.00$  mm.

The spent females appeared to have larger germarium than the one-day-old females. The length varied from 0.52 to 0.76 mm., or an average of  $0.66 \pm 0.00$  mm.; the width, from 0.17 to 0.34 mm. or an average of  $0.24 \pm 0.00$  mm.

#### *Vitellarium*

In newly emerged adults the vitellarium was empty, hyaline, and appeared as a small tube connecting the germarium to the oviduct. Three days after emergence of the adult, the first developing ovum was found in the vitellarium; it was increased to two on the fifth day and to three on the ninth day, the maximum number found in laying females. However, the number of developing ova in each vitellarium in the same individual was not constant. In all specimens dissected five days after emergence, ovarioles with one and two developing ova were noted in the same ovary. In laying females, including those about to reach the close of their period of fecundity, ovarioles with two and three developing ova were noted in the same individual.

#### *Number of eggs laid*

The number of eggs laid by the females throughout their life varied a great deal. The maximum number of eggs laid by a single individual was 1,669; the minimum, 281. The average number found for all the cultures was  $935.1 \pm 80.29$ , which represented only a minor portion (3.65 per cent) of the total number of oöcytes in one individual. From 72 to 90 per cent of the eggs were laid during the first three weeks of the period of fecundity.

The total number of egg batches laid varied from 13 to 67, or an average of  $36.4 \pm 2.54$ . Culture 2 which gave the greatest number of egg batch, 67 batches, laid 1,550 eggs, whereas culture 19 with only 57 batches of eggs

gave a total of 1,669 eggs. This indicated that there was no relation between the number of egg batch and the total number of eggs laid.

In Ceylon, Austin (1925) found the maximum number of eggs laid by an adult *Epilachna 28-punctata* to be 800. In Queensland, Australia, Temperley (1928) noted the maximum number laid to be 252 eggs from one individual and 125 from another of this same species. The average figure obtained in the present study approaches the figures of Austin, but are far above those of Temperley, which were even lower than 281, the minimum observed.

The number of eggs to a batch varied greatly in the different cultures (table 3). Culture 10, with 43.7, gave the greatest average number of eggs to a batch in individual females but the lowest number of batches in all the cultures, for the adult laid only 13 batches throughout its life. The lowest average number of eggs to a batch, 16.3, was given by culture 1. The total number of batch was 17. The female which gave the greatest number of batch (culture 2 with 67 batches) had an average of 23.1 eggs to a batch. In all the cultures the number of eggs to a batch varied from 6 (culture 4) to 52 (culture 22), or an average of  $29.1 \pm 1.22$ . Stanton (1903) found that the female deposited her eggs in batches of from 10 to 40 or 50. His figures represent a narrower range than those found in the present study.

The newly emerged adult did not begin laying until after a number of days after emergence, during which time ova developed in the vitellarium. The length of time from emergence to the first laying varied from 5 to 27 days, or an average of  $7.6 \pm 0.87$  days. It was observed that the female that had not begun laying until after 27 days refused to be covered by the male until the 27th day. Temperley (1928) found in her two cultures of *E. 28-punctata* that the period between emergence of the beetle and oviposition was 18 days in one culture and 16 days in the other.

The frequency of laying varied. Generally, the female laid a batch of eggs daily. In a few instances two batches of eggs were found laid in a day; in others, a period of rest was observed. The period of rest, or the number of resting days from laying of the first eggs to laying of the last eggs, varied from 0 to 43, or an average of  $14.9 \pm 1.95$  days (table 3). As the same table shows, the number of resting days did not affect the total number of eggs laid. Culture 19, which gave the greatest number of eggs laid, had 25 resting days, whereas culture 25, with a total of 821 eggs laid, had 43 resting days. In all the cultures, only cultures 2, 6, 19, and 23 laid two batches of eggs a day in some instances; culture 2 laid thrice, cultures 6 and 19 once each, and culture 23 twice.

#### *Longevity of female adults and period of fecundity*

The length of life of the females varied from 27 to 96 days. The average for all the cultures was  $60.1 \pm 3.51$  days.

The period of fecundity ranged from 31 to 88 days, or an average of  $53.8 \pm 2.98$  days; within this period the female was able to lay all the eggs it could lay before its death. The female with the longest period of fecundity did not necessarily lay the greatest number of eggs. Culture 19 which gave the greatest total number of eggs laid (1,669) had a period of fecundity of 80 days, whereas culture 25 which gave the longest period of fecundity

(88 days) laid only a total of 821 eggs. Again, culture 6 with only a period of fecundity of 58 days laid a total of 1,589 eggs.

The length of time from the laying of the last eggs to the death of the female varied from 1 to 17 days, or an average of  $6.1 \pm 0.85$  days. In most of the cultures this period ranged from 1 to 8 days, but in three cultures, it was 12 days in one and 17 days in each of the other two.

#### SUMMARY AND CONCLUSIONS

1. The number of ovarioles in one ovary of the tomato lady beetle varied considerably. In one-day-old females, the number in the right ovary, based on 272 individuals, ranged from 22 to 42, or an average of  $34.3 \pm 0.16$ ; that in the left ovary, from 19 to 41, or an average of  $34.1 \pm 0.19$ . These figures did not vary considerably from those of the spent females, which ranged from 24 to 40, or an average of  $34.8 \pm 0.41$ , in the right ovary and from 21 to 40, or an average of  $34.2 \pm 0.49$ , in the left.

2. The number of oöcytes in an ovariole in one-day-old females, based on 51 individuals with a total of 510 ovarioles, varied from 248 to 534, or an average of  $376.8 \pm 1.54$ . On the basis of 68 ovarioles to an average female, each female is potentially capable of laying as many as 25,622 eggs in its lifetime. In spent females, the number of oöcytes, based on 23 individuals with a total of 230 ovarioles, varied from 202 to 402, or an average of  $350.6 \pm 2.68$ . On the basis of 68 ovarioles to a spent female, each female is potentially capable of laying as many as 23,841 more eggs before its death.

3. There was no marked difference in the number of oöcytes of one-day-old and of spent females.

4. There was a marked increase in size of the germarium as the adult grew older. The average increase in length was 0.123 mm.; the average increase in width, 0.061 mm.

5. Of the total oöcytes or potential eggs in an adult, only a small percentage (3.65 per cent) was actually laid.

6. The total number of eggs laid varied considerably; the range was from 281 to 1,669, or an average of  $935.1 \pm 80.29$ . From 72 to 90 per cent of the eggs were laid in the first three weeks of the period of fecundity.

7. Generally, a batch of eggs is laid daily. In a few instances, two batches were laid in one day; in others, a period of rest was observed.

8. The average number of eggs to a batch laid by different adults varied from 16.5 to 43.7. The number of eggs to a batch, in all the cultures, varied from 6 to 52, with an average of  $29.1 \pm 1.22$ .

9. The longevity of the female adults varied from 27 to 96 days, or an average of  $60.1 \pm 3.51$  days.

10. The adults laid the first batch of eggs 5 to 27 days, or an average of  $7.6 \pm 0.87$  days, after emergence.

11. The vitellarium in laying adults contained a maximum of 3 and a minimum of 2 developing ova.

12. The first or oldest ova in the female did not all develop at the same rate. The first ovum of laying adults varied in size.

13. Counts made on the ovariole showed that an average female could lay the maximum of 68 eggs in one oviposition. However, this number of eggs to a batch was not obtained in the present investigation.

## LITERATURE CITED

- AUSTIN, G. D. 1925. Some beetle pests of cucurbits in Ceylon. Ceylon Dept. Agric. Year-book for 1925: 41-47. Pl. 1-2.
- DIEKE, G. H. 1947. Lady beetles of the genus *Epilachna* (Sens. Lat.) in Asia, Europe, and Australia. Smithsonian Misc. Coll. **106**(15): 1-180. Pl. 1-27.
- STANTON, W. A. 1903. Entomological notes. Observation on insects affecting the crops in the Philippines. Ladybird enemy of the tomato. *Epilachna 28-punctata*. Philippine Weather Bureau Bulletins for the year 1903: 15-17.
- TEMPERLEY, M. C. 1928. The leaf-eating ladybird. Queensland Agric. Jour. **30**: 11-16.
- UICHANCO, L. B. 1915. Some tests of tomatoes. The Philippine Agriculturist and Forester **4**: 59-80.

TABLE I

*Counts on ovarioles and oöcytes and measurements on germarium of one-day-old females*

	NUMBER OF INDIVIDUALS		FIDUCIAL LIMITS (COMPUTED RANGE)
Number of ovarioles in right ovary			
Maximum		42	
Minimum		22	
Average	272	$34.3 \pm 0.16$	33.7—35.4
Number of ovarioles in left ovary			
Maximum		41	
Minimum		19	
Average	272	$34.1 \pm 0.19$	33.3—35.1
Number of oöcytes in one ovariole			
Maximum		534	
Minimum		248	
Average	510	$376.8 \pm 1.54$	183.8—193.1
Length of germarium in millimeter			
Maximum		0.64	
Minimum		0.39	
Average	510	$0.53 \pm 0.00$	0.53—0.54
Width of germarium in millimeter			
Maximum		0.24	
Minimum		0.14	
Average	510	$0.18 \pm 0.00$	0.18

TABLE 2

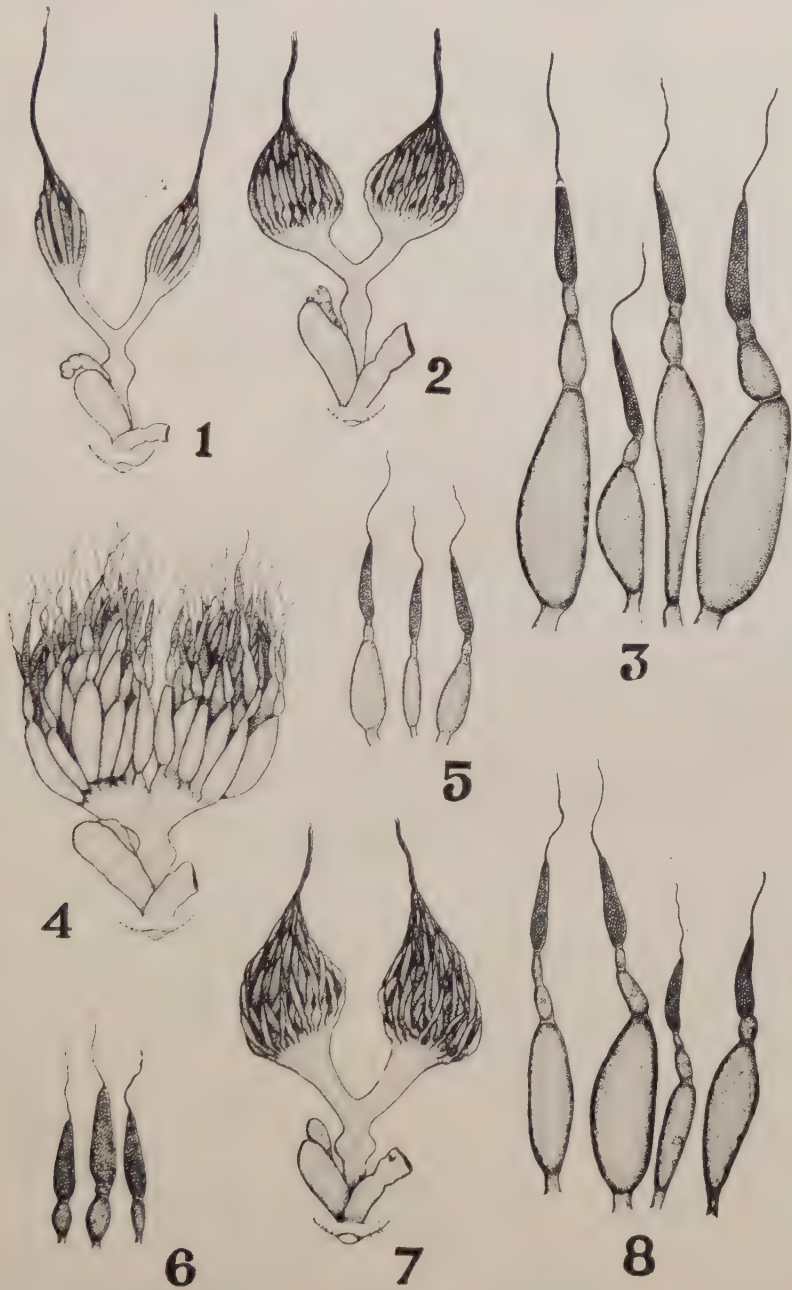
*Counts on ovarioles and oöcytes and measurements on germarium of spent females*

	NUMBER OF INDIVIDUALS		FIDUCIAL LIMITS (COMPUTED RANGE)
Number of ovarioles in right ovary			
Maximum		40	
Minimum		24	
Average	88	$34.8 \pm 0.41$	33.5—36.0
Number of ovarioles in left ovary			
Maximum		40	
Minimum		21	
Average	88	$34.2 \pm 0.49$	33.7—36.4
Number of oöcytes in one ovariole			
Maximum		402	
Minimum		282	
Average	230	$350.6 \pm 2.68$	167.2—183.3
Length of germarium in millimeter			
Maximum		0.76	
Minimum		0.52	
Average	230	$0.66 \pm 0.00$	0.65—0.66
Width of germarium in millimeter			
Maximum		0.34	
Minimum		0.17	
Average	230	$0.24 \pm 0.00$	0.24—0.25

TABLE 3

*Summary of records on reproduction in Epilachna philippinensis (based on 28 females)*

		FIDUCIAL LIMITS (COMPUTED RANGE)
Days from emergence to first laying		
Maximum.....	27	
Minimum.....	5	
Average.....	7.6 $\pm$ 0.87	6.1—10.3
Period of fecundity in days		
Maximum.....	88	
Minimum.....	31	
Average.....	53.8 $\pm$ 2.98	44.9—62.8
Number of resting days during period of fecundity		
Maximum.....	43	
Minimum.....	0	
Average.....	14.9 $\pm$ 1.95	10.1—20.7
Number of days from laying of last eggs to death of adult		
Maximum.....	17	
Minimum.....	1	
Average.....	6.1 $\pm$ 0.85	3.5—8.6
Longevity of female adults in days		
Maximum.....	96	
Minimum.....	27	
Average.....	60.1 $\pm$ 3.51	52.5—70.5
Total number of eggs laid		
Maximum.....	1669	
Minimum.....	281	
Average.....	935.1 $\pm$ 80.29	694.3—1176.0
Total number of egg batches laid		
Maximum.....	67	
Minimum.....	13	
Average.....	36.4 $\pm$ 2.54	28.7—44.0
Number of eggs to a batch		
Maximum.....	52	
Minimum.....	6	
Average.....	29.1 $\pm$ 1.22	22.5—30.2



VIADO: REPRODUCTIVE CAPACITY OF THE TOMATO LADY BEETLE

## DESCRIPTION OF ILLUSTRATION

## PLATE I

- Fig. 1. Reproductive system in newly emerged female.  $\times 20$ .  
Fig. 2. Reproductive system in 5-day-old female.  $\times 20$ .  
Fig. 3. Ovarioles from a 30-day-old female which laid 24 batches with a total of 622 eggs.  
 $\times 40$ .  
Fig. 4. Reproductive system in 30-day-old female which laid 24 batches with a total of 622  
eggs.  $\times 20$ .  
Fig. 5. Ovarioles from a 65-day-old female which laid 42 batches with a total of 1,076 eggs.  
 $\times 40$ .  
Fig. 6. Ovarioles from a 5-day-old female.  $\times 40$ .  
Fig. 7. Reproductive system in 65-day-old female which laid 42 batches with a total of  
1,076 eggs.  $\times 20$ .  
Fig. 8. Ovarioles from a 60-day-old female which laid 37 batches with a total of 993 eggs.  
 $\times 40$ .

# THE INFLUENCE OF ARTIFICIAL ILLUMINATION ON THE EGG PRODUCTION OF NEW HAMPSHIRE YEARLING HENS<sup>1</sup>

ROBERTO E. FRONDA

In the United States, artificial lighting is used to increase egg production during winter. As eggs are generally scarce and their prices are high during the rainy months in the Philippines, a study to determine whether or not artificial illumination would be profitable under local conditions was conducted from October 16, 1948, to October 15, 1949, in the Departments of Agricultural Engineering and of Animal Husbandry.

## REVIEW OF LITERATURE

Experiments at Cornell University showed that artificial lighting stimulated egg production during the fall and winter months when prices of eggs are highest. Hurd (1946) claimed, however, that the use of artificial illumination alone does not guarantee good egg production. The other attending factors are the number of hours of artificial lighting, the physical condition of the stock, the ration, and the season.

In the United States, artificial illumination is used in the evening or morning, or both morning and evening. Kennard and Chamberlin (1931) recommend all-night light for winter layers. The lights should be dimmed gradually, for turning off the lights abruptly causes the birds to stop laying eggs (Rice and Botsford, 1946). The light may or may not be shaded. Even if shaded, it should reach the roosting quarters and should cover most of the floor space (Kennard and Chamberlin, 1930).

## MATERIALS AND METHODS

*The stock.* A flock of 60 New Hampshire yearling layers that had just completed their annual molt was used. The birds were randomly distributed into two lots of 30 birds each. They were weighed at the beginning of the experiment and monthly thereafter until the close of the study. Lot I was given artificial illumination from four o'clock in the morning to daylight during the first four months, from October 16, 1948, to February 15, 1949. The lighting device consisted of a 75-watt electric bulb suspended about one meter above the feeding trough. In this position the roosting place was partially lighted. Lot II, the control, was not lighted. Both lots were housed in adjacent pens provided with enough roosting space and trapnests.

*Feeding and care.* Except for artificial illumination in lot I, both lots were given identical management and care. They were given the same

<sup>1</sup>Experiment Station Contribution No. 1582. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1950. Prepared in the Departments of Agricultural Engineering and Animal Husbandry under the direction of Associate Professor Alejandro B. Catambay and Professor F. M. Fronda.

ration consisting of grain, cracked corn, and mash, one part by weight of the grain to two of the College laying mash, which consisted of two parts of fish meal, one of ground yellow corn, three of copra meal, and four of fine rice bran. The feed was made available to both lots in open feeding troughs kept filled at all times. Ground shells were placed in wooden troughs. Drinking water was available to the birds in open drinking troughs. A grassy run was accessible to the birds of both lots.

*Records kept.* The initial and monthly weights of the birds in both lots, their egg production, the amount and cost of feeds consumed, and the mortality were recorded.

#### RESULTS AND DISCUSSION

##### *Egg production*

Table 1 shows the comparative percentage of production and distribution of eggs of both lots during the year. The percentage of egg production is determined by dividing the actual number of eggs laid within the period by the total possible number of eggs, and multiplying the quotient by 100. Table 1 also shows that lot II followed the normal trend of egg production reported by Fronda in 1928. This lot produced more eggs during the period from December to April than during the rest of the year. On the other hand, lot I, which was provided with light, had a comparatively low production from December to April. It, however, produced more eggs than the control during November and from May to the end of the experiment.

The performance of the individual birds in both lots could not be compared because a considerable number of eggs were laid by the birds outside of the trapnest. Since such eggs cannot be assigned to any particular bird, their number may be included in the comparison only when the birds are treated as a flock. During the year, lot I had a total annual production of 29.5 per cent and lot II, 30.9 per cent, or a difference of only 1.4 per cent. Studies in the United States and Canada showed a similar result—the use of artificial light did not increase egg production, but it made a more even distribution (Jull, 1946; Hurd, 1946; Winter and Funk, 1947). The use of artificial light in this study apparently hastened the laying of eggs. Table 1 shows that egg production during the first month was higher in the lighted pen than in the unlighted one. During the first two weeks of lighting, the percentage of egg production increased from 13.6 per cent to 28.3 per cent and, during the next two weeks, to 40.4 per cent. In the unlighted pen the increase was from 10.0 per cent to 19.4 per cent during the first two weeks and to 31.6 per cent during the next two weeks.

Lippincott and Card (1946) reported that layers will respond to lights in seven to ten days. Rice and Botsford (1946) and Staffe (1948) also stated that layers should respond to lights within two weeks after the lights have been started. The results of the present study indicate that the use of lights hastened the onset of production after recovery from their annual molt. Hence, if it is desired to secure as many eggs as possible soon after the flock has recovered from its annual molt, the use of artificial lights may be used to advantage.

There was a definite tendency for the birds in lot I to produce more eggs during the last five months of the test than those in lot II. Jull (1943) noted that artificial light helps maintain good egg production in late summer and early fall months. Rice, Hall, and Marble (1930) stated that artificial illumination shifts production from the season of low-priced eggs (in the spring months) to the season of high-priced eggs (in the late summer, fall, and early winter months). The writer found that the lighted birds maintained a higher level of egg production and a more even distribution during the year than the unlighted ones.

The lights in lot I were removed on February 15. As was expected, the birds started to molt as early as March, about two months ahead of the birds in the unlighted pen. Nevertheless, the lighted birds maintained a fair level of egg production.

#### *Feed consumption and cost*

The average feed consumption of each bird in lot I was 40.3 kg., and in lot II, 38.5 kg., the difference between the two lots being only 1.8 kg. (table 2). This little increase in the amount of feed consumed by the lighted birds may be partly attributed to the lengthened feeding time. Callenbach, Nicholas, and Murphy (1943) showed that the availability of feed was not a factor affecting the egg production of birds kept under artificial illumination.

The birds in lot I needed 4.5 kg. of feed and those in lot II, 4.1 to produce a dozen eggs in each lot, showing that lot II was slightly more efficient than lot I in converting the feed into eggs. During this study, lot I needed ₱1.02 worth of feed to produce a dozen eggs, and lot II, ₱0.93, making a difference of ₱0.09 only. As lot II produced 267 more eggs than lot I during the year, the returns above feed cost were ₱218.89 in lot II and only ₱175.28 in lot I.

#### *Weight of the birds*

Table 3 shows that the birds in both lots maintained their weights fairly well during the year. The birds in lot I had an initial weight of 2.11 kg. and a final weight of 2.36 kg., the average during the year being 2.29 kg. The birds in lot II had an initial weight of 2.10 kg. and a final weight of 2.25 kg., with an average of 2.25 kg. The difference of 40 grams between the average weights of the lots showed that the use of artificial lights did not influence the weight of the birds in lot I.

#### *Mortality*

During the experiment, nine of the thirty layers died in lot I, and six layers died in lot II. The rate of mortality in lot I was 10 per cent higher than that of lot II. As most of the deaths in lot I were physical rather than pathological in nature, it may be possible that the use of artificial lights in lot I had tended to weaken the birds. This result was corroborated by Callenbach, Nicholas, and Murphy (1943) who reported a greater mortality in pens supplied with artificial illumination than in those without. Later, Nicholas, Callenbach, and Murphy (1944) observed that there was no relationship between experimental light treatments and flock mortality

as to amount, distribution or cause. It is probable that the layers that were given artificial illumination (lot I) were not quite in proper physical condition when the experiment was started. Unless the birds are in good physical condition, the use of artificial light may prove to be a dangerous experiment (Rice, Hall, and Marble, 1930).

## SUMMARY

1. Artificial illumination had no influence on the annual rate of egg production and on the weight of New Hampshire yearling hens, although it tended to hasten the onset of egg production after recovery from their annual molt. The lighted birds maintained a higher rate of egg production than the unlighted birds towards the last five months of the year.

2. The birds in the lighted pen consumed a little more feed than those in the unlighted one.

3. The rate of mortality was slightly higher in the artificially illuminated pen than in the control.

4. The results of the study tend to show that artificial illumination cannot be profitably used on yearling hens in this country.

## LITERATURE CITED

- CALLENBACH, E. W., J. E. NICHOLAS, AND R. R. MURPHY. 1943. Effect of light and availability of feed on egg production. Penn. State Coll. Agric. Exper. Sta. Bull. 455: 1-14.
- FRONDA, F. M. 1928. The seasonal distribution of egg production. The normal egg production curve. Philippine Agriculturist 17: 25-36.
- HURD, LOUIS M. 1946. Modern poultry farming. ix + 599 p., 219 fig. New York: The Macmillan Book Company.
- JULL, MORLEY A. 1943. Successful poultry management. xi + 467 p., 187 fig. New York: McGraw-Hill Book Company, Inc.
- JULL, MORLEY A. 1946. Poultry breeding. 2nd ed., xiv + 484 p., 76 fig. New York: John Wiley & Sons, Inc.
- KENNARD, D. C., AND V. D. CHAMBERLIN. 1930. Poultry. Ohio (Wooster) Agric. Exper. Sta. Sp. Cir. 28: 1-32.
- KENNARD, D. C., AND V. D. CHAMBERLIN. 1931. All-night light for layers. Ohio (Wooster) Agric. Exper. Sta. Bull. 476: 1-22.
- LIPPINCOTT, WILLIAM ADAMS, AND LESLIE E. CARD. 1946. Poultry production. 440 p., 286 fig. Philadelphia: Lea & Febiger.
- NICHOLAS, J. E., E. W. CALLENBACH, AND R. R. MURPHY. 1944. Light intensity as a factor in the artificial illumination of pullets. Penn. State Coll. Agric. Exper. Sta. Bull. 462: 1-24.
- RICE, JAMES E., AND HAROLD E. BOTSFORD. 1946. Practical poultry management. 4th ed., xi + 604 p., 333 fig. New York: John Wiley & Sons, Inc.
- RICE, JAMES E., GOLDAN O. HALL, AND DEAN R. MARBLE. 1930. Judging poultry for production. xii + 425 p., 205 fig. New York: John Wiley & Sons, Inc.
- STAFFE, D. 1948. On the influence of several environment factors on laying capacity, hatching, brooding, growth, and moulting. Official Report, Eighth World's Poultry Congress 1: 142-147.
- WHETMAN, E. O. 1933. Factors modifying egg production with special reference to seasonal changes. Jour. Agric. Sci. 23: 383-418.
- WINTER, A. R., AND E. M. FUNK. 1947. Poultry science and practice. Revised. vii + 739 p., 260 fig. Chicago: J. B. Lippincott Co.

TABLE 1

*Distribution of egg production of New Hampshire yearling hens with and without artificial illumination*

PERIOD	LOT I (WITH LIGHT) <sup>a</sup>		LOT II (WITHOUT LIGHT)	
	No. of eggs laid	Percentage production	No. of eggs laid	Percentage production
October 16—November 15.....	316	34.2	235	25.3
November 16—December 15.....	360	41.5	372	42.2
December 16—January 15.....	312	37.3	402	44.7
January 16—February 15.....	284	33.9	362	40.9
February 16—March 15.....	193	25.5	349	45.1
March 16—April 15.....	192	22.9	369	44.8
April 16—May 15.....	229	28.4	234	30.6
May 16—June 15.....	218	29.7	162	21.3
June 16—July 15.....	197	28.6	183	25.4
July 16—August 15.....	208	32.0	183	24.6
August 16—September 15.....	125	19.2	120	16.1
September 16—October 15.....	86	13.6	16	2.1
Annual.....	2,720	29.5	2,989	30.9

<sup>a</sup> Lights on from October 15, 1948, to February 15, 1949.

TABLE 2

*Amount and cost of feed consumed by New Hampshire yearling hens with and without artificial illumination*

ITEMS	LOT I (WITH LIGHTS)	LOT II (WITHOUT LIGHTS)
Amount of feed consumed, kilograms <sup>a</sup> .....	1020.9	1014.0
Cost of feed consumed, pesos <sup>b</sup> .....	230.72	229.16
Average feed consumed by each bird, kilograms.....	40.3	38.3
Cost of feed consumed by each bird, pesos.....	9.11	8.66
Total number of eggs produced.....	2720	2987
Value of eggs produced, pesos <sup>c</sup> .....	406.00	448.05
Amount of feed needed to produce a dozen eggs.....	4.5	4.1
Cost of feed needed to produce a dozen eggs, pesos.....	1.02	0.93
Returns above cost of feed, pesos.....	175.28	218.89

<sup>a</sup> One part grain and two parts mash by weight.

<sup>b</sup> The average cost of a kilogram of feed was ₱0.226 (grain, ₱0.27; mash, ₱0.204).

<sup>c</sup> Eggs were valued at ₱1.80 a dozen.

TABLE 3

*Average monthly weights of New Hampshire yearling hens with and without artificial illumination*

DATE	LOT I (WITH LIGHT)	LOT II (WITHOUT LIGHT)
	<i>kg.</i>	<i>kg.</i>
October 15.....	2.11	2.10
November 15.....	2.19	2.22
December 15.....	2.19	2.31
January 15.....	2.35	2.37
February 15.....	2.26	2.30
March 15.....	2.29	2.25
April 15.....	2.38	2.29
May 15.....	2.32	2.18
June 15.....	2.30	2.20
July 15.....	2.34	2.28
August 15.....	2.36	2.27
September 15.....	2.36	2.25
Average.....	2.29	2.25

# HYBRIDIZATION OF CULTIVATED AND WILD RICE<sup>1</sup>

JOSÉ M. CAPINPIN AND ALFREDO B. MAGNAYE  
*Of the Department of Agricultural Botany*

WITH ONE TEXT FIGURE

The production of hybrids between cultivated and wild rice and the study of the different botanical and genetical characteristics of the resulting cross were conducted from July, 1948, to October, 1949, in the Department of Agricultural Botany, College of Agriculture.

Jones and Longley (1941) cited several investigators who worked on interspecific breeding of rice. Ramiah, according to them, reported in 1934 a successful cross between *O. sativa* and *O. latifolia*, both of which have 24 somatic chromosomes. Gotoh and Okura (1935) reported on crosses between *O. sativa* and *O. cubensis*. Gotoh also made the cross of Colusa *O. sativa* × *O. cubensis* in 1933 and reported that the F<sub>1</sub> plants were sterile and more like *O. cubensis* than Colusa. Both writers found that *O. sativa* and *O. cubensis* have 24 somatic chromosomes.

Ramanujam (1937) stated that sterile F<sub>1</sub> hybrids were obtained when a cross was made between *O. sativa* and *O. officinalis*. When the F<sub>1</sub> was backcrossed with *O. sativa*, six triploid plants were obtained. Jones and Longley also cited Morinaga and Aoki (1938) who reported that the F<sub>1</sub> plants of the cross between *O. latifolia* and *O. minuta* and reciprocal, both tetraploid species, were relatively low in fertility. In 1931 Ramiah found that parthenocarpic seeds were produced when a cross was attempted between *O. sativa* and wild rice, *O. longistaminata*.

Capinpin (1938) reported a case of triploidy in the first generation cross between cultivated rice (*O. sativa*) and wild rice (*O. minuta*).

Ting (1933) described a hybrid between wild and cultivated rice in Kwantung, China, as possessing some characteristics superior to those of the cultivated variety and some inherited from its wild parent.

## MATERIALS

### *Varieties used: Fortuna and wild rice*

Fortuna (*Oryza sativa* Linn.) is a dual-purpose rice. When planted under upland conditions, it produces long and slender grains (Capinpin and Lopez, 1948). Its glumes when mature are straw-colored and have purple pigmentation at the apical end. Later, this purple pigmentation fades. In the present investigation Fortuna was cultured under upland conditions.

The seeds of wild rice (*Oryza minuta* Merr.) were obtained from Sorogon through the courtesy of Dr. N. B. Mendiola, Senior Plant Breeder

<sup>1</sup>Experiment Station Contribution No. 1583. Based on the thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1950. Conducted in the Department of Agricultural Botany under the supervision of the senior author.

of the Bureau of Plant Industry, Manila. The grains are small and long-awned. The glumes turn almost black when fully mature.

#### EXPERIMENTAL PROCEDURE

##### *Planting*

Two hundred and forty seeds of each variety which had been soaked in tap water for 24 hours were sown separately on July 12, 1948, in six kerosene cans cut crosswise and filled with Lipa clay loam soil. For convenience in controlled pollination work, the plants were allowed to grow 25 centimeters apart.

##### *Technique of controlled pollination*

Emasculation was done early in the morning, usually two to three hours before dehiscence. The clip method of emasculation followed by Mulimbayan (1935), which consists of cutting with a pair of scissors from one fourth to one third of the upper portion of the unopened flowers, was employed. The rice florets were emasculated usually a day before their emergence from the leaf sheath because at this stage no self-pollination had yet occurred. The florets that were not emasculated were cut off to prevent contamination in the process of hybridization.

After emasculation each panicle was covered with a cellophane bag to prevent natural cross-pollination. Pollen grains from wild rice were placed in a watch glass and were applied with a needle to the stigmas of the emasculated flowers of Fortuna. All the pollinated panicles were bagged, labeled, and staked to prevent breakage.

Direct and reciprocal crosses between Fortuna and wild rice were performed.

##### *Culture of the hybrid grains and the parental types*

The hybrid seeds were abnormal in form, the exposed upper portion being smaller than the covered part. Special care was therefore observed in germinating them. The seeds were germinated in moist sterilized sand contained in porcelain tumblers. On January 7, 1949, the seedlings were transplanted into the culture pots, one plant to a hill. Representative seeds from the parental types were sown in separate kerosene cans which had been punctured at the bottom for drainage.

#### RESULTS AND DISCUSSION

The results of the direct crosses between Fortuna and wild rice indicated a very low compatibility. Only six hybrid seeds were produced out of 356 trials of cross-pollination, giving a crossing percentage of only 1.6 per cent. This low fertility may be attributed to the high sterility of the pollen grains of wild rice, as evidenced by the incomplete development of the anthers and their contents (Ting, 1933).

In the reciprocal crosses between wild rice and Fortuna, the 245 treated florets were destroyed during the pollination because in the transfer of pollen grains from Fortuna to the stigmas of wild rice, the stigmas were

pulled up by the needle. Also, because of the shattering characteristics of wild rice, a slight touch caused the florets to fall.

*Botanical descriptions of hybrids and of parental types*

(a) *Root—branching and length.* The roots of wild rice were abundant and finely branched; those of Fortuna and the  $F_1$  plants had poorly developed branched roots and small fibrous rootlets. Fortuna had the longest roots, with a mean length of 14.3 centimeters. The roots of the  $F_1$  plants had a mean length of 13.3 centimeters and those of wild rice, 3.6 centimeters.

(b) *Culm—length and number of maturing shoots.* The culms were measured from the base to the tip of the panicle.

The highest mean number of maturing shoots was obtained from wild rice, which had a mean of 14 maturing shoots to a hill, with a mean length of 36.1 centimeters. Fortuna had a mean of nine maturing shoots with a mean length of 87.6 centimeters; the  $F_1$  plants, a mean of six maturing shoots with a mean length of 82.3 centimeters. Fortuna and the  $F_1$  plants gave lower maturing shoots because they were badly attacked by the rice bug, *Leptocorisa acuta* Thunberg, and the rice stem borer, *Scheonobius incertellus* Walker, during the milk stage.

(c) *Leaf.* In determining the color of the vegetative parts, Ridgway's (1912) *Color Standards and Color Nomenclature* was used.

The leaves of the three varieties were linear-lanceolate and glabrous. The colors varied slightly, the leaves of Fortuna and the  $F_1$  plants being calliste green to yellow green and those of wild rice, grass green.

The leaf sheaths of Fortuna and the  $F_1$  plants were glabrous outside and yellow green to calliste green towards the base. Wild rice had smooth, cress green leafsheaths.

(d) *Flower.* During sunny days wild rice florets opened as early as 6:30 a. m. Dehiscence of pollen started as early as 7:00 a. m., and not, as Ting (1933) had reported on wild rice in Kwantung, China, from 10:00 a.m. to 3:00 p.m., and in some cases, as late as 5:00 p.m.

In the Fortuna variety, anthesis occurred at 7:00 a.m. Dehiscence of pollen began at 7:30 a.m. during sunny days and lasted till 2:00 p.m.

In the  $F_1$  plants anthesis and dehiscence of pollen usually occurred at about the same time as those of the Fortuna variety. During adverse conditions, however, delayed anthesis and dehiscence were observed in the three varieties.

(e) *Panicle.* The rachises of Fortuna and of the  $F_1$  plants were hollow at the internode, except where the rachillae were borne. The rachilla was triangular and had distinct grooves. In wild rice the rachis was grooved and slightly glabrous. The spikelets were shed even when they were immature.

(f) *Caryopsis.* Measurements of the length and breadth of the grains with a micrometer caliper showed that the hybrids produced grains intermediate between the parents, a result similar to that reported by Capinpin and Punyasingh (1938), who found that in the  $F_1$  progenies of a number of crosses of Philippine and Siamese rice varieties, the grains were intermediate in breadth between the parents. The average breadth of the  $F_1$  grain was 19.03 per cent narrower than that of the maternal parent (Fortuna),

but was 27.81 per cent wider than the grain of the paternal variety (wild rice). Moreover, the average breadth of the hybrid grain was 8.05 per cent wider than the average of the two parents.

The hybrid produced grains intermediate in length between its parents, the same observation noted by Capinpin and Punyasingh (1938) on all the  $F_1$  grains of nine crosses with Siamese rice varieties. The average length of grain of the  $F_1$  progeny was 10.01 per cent shorter than the long-grained maternal parent (Fortuna) and 95.86 per cent longer than that of the short-grained paternal parent (wild rice). Compared with the average length of grain of the two parents, the average length of the grain of the hybrid exhibited an increase of 23.32 per cent. The mean differences in length of grain of the three varieties were significant.

The lower and upper empty glumes in Fortuna and the  $F_1$  grains were similar in size and shape. They were triangular to linear-lanceolate and somewhat flattened, and their concave sides were directed towards the axis of the spikelet. At flowering time, the glumes were pale green, more or less shiny, and glabrous, but at maturity their color changed to straw or ivory white and they became brittle and hard. When young and immature, the lemma was usually pale green and possessed from a few to several outgrowths or hairs on its upper portion. At maturity the lemma became nearly straw-colored or light ochraceous buff in Fortuna and pale ochraceous-salmon in the hybrid.

The outer glume of wild rice was one-third the length of the lemma, ovate, white, and coriaceous. The lemma was slightly convex or straight; the palea was straight. At maturity the lemma and palea became blackish or ash colored. The grains had long awns, some as long as 1.5 centimeters, red when unripe, and faded when ripe. The awn was rough, granular, and nonstraited.

(g) *Germination.* Wild rice germinated in eleven days, the (wild rice  $\times$  Fortuna)  $F_1$  seven days, and Fortuna four days. The Fortuna variety had the highest percentage of germination, 87.05, and wild rice, the lowest, 12.08. The hybrid had a percentage germination of 77.0, which was intermediate between its parents.

(h) *Habit of growth from seedling to maturity.* The wild rice seedlings responded to heavy watering in the dry season, although they showed signs of resistance to drought. Each tiller formed an angle with the rachis so that an open stool was produced. The tillers did not tend to lodge. Their spikelets were shed before they were fully mature.

Fortuna and the  $F_1$  plants had practically the same habit of growth and were adversely affected by the lack of water. The tillers were closely grouped together and maintained an almost vertical position. Because of their weight, they lodged a little at maturity.

#### *Morphological characters*

*Presence of pigments.* The leaves of Fortuna and the  $F_1$  plants were identical in color—calliste green to yellow green. The empty glumes were ivory white and the leaf sheaths, yellow green to calliste green. The lemma was straw-colored or ochraceous buff in Fortuna and pale ochraceous-salmon in the  $F_1$  plants. Fortuna and the  $F_1$  plants differed slightly from wild rice

in having grass-green leaves, cross-green leaf sheaths, white empty glumes, and blackish or ash-colored lemmas.

*Growth habit of the culm and shattering characteristics*

All the culms in Fortuna and in the  $F_1$  plants were erect. The tendency reported by Ramiah (1937), that the erect habit of the rice tillers is usually associated with a nonlodging nature, was also observed in the two varieties (Fortuna and  $F_1$  plants). The culms of wild rice developed a little bit inclined, forming an angle and assuming a prostrate position. Fortuna and the  $F_1$  plants were not of the shattering type, unlike those of wild rice which shattered easily. Fortuna and the  $F_1$  plants, especially the latter, were very susceptible to pests in the milk stage.

Capinpin and Punyasingh (1938) obtained nonshattering  $F_1$  plants when Macan Pulot, a shattering variety, was crossed with nonshattering Nang Tani. This was also proved by Kato in 1916 in Japan, as reported by Matsura in 1929. Kadam in 1936 found that the nonshattering characteristic was dominant in a cross between cultivated and wild rice (Capinpin and Punyasingh, 1938).

*Awn character.* Both the Fortuna and the  $F_1$  plants were awnless; wild rice was long-awned.

*Percentage of filled grains.* There was a marked difference in the percentage of filled grains among the three varieties. Fortuna had 89.29 per cent of filled grains; wild rice, 50.71; and  $F_1$ , 16.76.

The presence of white empty grains seemed to indicate that more  $F_1$  plants succumbed to the attack of insect pest during the milk stage than either of the parent plants.

*Physiological characters*

*Comparative ages at flowering and maturity.* Wild rice flowered in 71 days after sowing and matured in 93 days; the  $F_1$  plants flowered in 97 days and matured in 127 days; the Fortuna variety flowered in 100 days and matured in 139 days. The hybrid plant was intermediate with regard to the flowering age and was nearer to the late-flowering parent (Fortuna). This finding corroborates that of Capinpin and Punyasingh (1938), who reported that the flowering age of the  $F_1$  plants may be intermediate between its parents because of their nearness to the late-flowering parent.

Figure 1 shows the appearance of the three varieties at maturity.

*Susceptibility to plant pests and diseases.* The rice bug, *Leptocorisca acuta* Thunberg, and the rice stem borer, *Schoenobius incertellus* Walker, seriously affected the Fortuna and the  $F_1$  plants. Dried panicles with empty grains were observed in these two varieties. To minimize damage to the plant, the rice bugs were controlled by hand picking and the rice stem borers, by flooding. To retain the water in the cans, the drainage holes at the bottom and the sides of the cans were plugged with asphalt. Wild rice showed resistance to these two pests. No fungous or bacterial disease attacked the three varieties during the entire growing period.

A summary of the morphological and physiological characters observed in (Fortuna  $\times$  Wild rice)  $F_1$  is given in table 3.



Fig. 1—Parental types and  $F_1$  hybrid of the rice used: left, Fortuna; middle, (Fortuna  $\times$  wild rice)  $F_1$ ; and right, wild rice.

#### SUMMARY

1. A very low compatibility was indicated by the results of the direct crosses between Fortuna and wild rice. No crossbred grains were obtained when wild rice was used as the pistillate parent and Fortuna as the pollinator.

2. It took wild rice eleven days to germinate, the  $F_1$  plants seven days, and Fortuna four days. The hybrid is intermediate between its parents in germination, as well as in percentage of germination.

3. The  $F_1$  plants were intermediate between the parents in length of tillers.

4. There was a significant difference in mean length and breadth of grains between any two of the three varieties. The hybrid grain is intermediate in length and breadth between its parents. It was narrower and shorter than the maternal parent (Fortuna), but wider and longer than the paternal parent (wild rice).

5. The absence of awns in Fortuna was dominant over the presence of awns in wild rice. Also, the ivory white color of the empty glumes of Fortuna was dominant over the white color of those of wild rice.

6. Wild rice flowered in 71 days after sowing and matured in 93 days; the  $F_1$  plants flowered in 97 days and matured in 127 days; and the Fortuna variety flowered in 100 days and matured in 139 days.

## LITERATURE CITED

- CAPINPIN, J. M. 1938. Experimental production of triploidy in rice. Nat. Res. Council of the Philippines. Bull. 16: 39.
- , AND K. PUNYASINGH. 1938. A study of varietal crosses and hybrid vigor in rice. Philippine Agriculturist 27: 255-267.
- , AND R. R. LOPEZ. 1948. Variability in plant and grain characters of Fortuna rice as influenced by methods of culture. Philippine Agriculturist 32: 150-164.
- JONES, W. J., AND A. E. LONGLEY. 1941. Sterility and aberrant chromosome numbers in Caloro and other varieties of rice. Jour. Agric. Res. 62: 394-395.
- MULIMBAYAN, M. B. 1935. A comparative study of two methods of emasculating rice flowers for artificial hybridization work. Philippine Agriculturist 24: 574-594.
- RAMIAH, K. 1937. Rice in Madras. A popular handbook. viii + 244 p. Madras. Superintendent of Government Press.
- RIDGWAY, R. 1912. Color standards and color nomenclature. iii + 42 p., 53 plates. Washington, D. C.: A. Hoen and Company.
- TING, Y. 1933. Wild rice of Kwantung and new variety bred from the hybrids of wild rice with cultivated rice. Agronomy Bulletin 3: 1-22.

TABLE 1  
*Comparison of the breadths of the grains of the three varieties*

GRAIN NO.	VARIETIES		
	Wild rice	(W. R. × F.) F <sub>1</sub>	Fortuna
	mm.	mm.	mm.
1	1.74	2.43	2.75
2	1.80	2.46	2.71
3	1.73	2.38	2.73
4	2.47	2.46	2.69
5	1.61	2.36	2.90
6	1.74	2.30	2.82
7	1.60	2.29	2.62
8	2.30	2.49	3.75
9	1.64	2.30	3.16
10	1.64	2.17	2.68
11	1.79	2.29	3.00
12	1.86	2.28	2.86
13	1.60	2.21	2.85
14	1.62	2.23	2.86
15	2.40	2.32	2.82
16	1.75	2.97	3.00
17	1.60	2.24	3.10
18	1.76	2.93	3.00
19	1.99	2.24	2.75
20	1.68	2.18	2.73
21	2.20	2.08	2.60
22	2.20	2.22	2.77
23	1.65	2.21	3.00
24	1.70	2.37	3.10
25	1.75	2.22	3.05
Total.....	45.82	58.63	72.30
Mean <sup>a</sup> .....	1.83	2.34	2.89

<sup>a</sup>L. S. M. D. = 0.13

TABLE 2  
*Comparison of the lengths of the grains*

GRAIN NO.	VARIETIES		
	Wild rice	(W. R. × F.) F <sub>1</sub>	Fortuna
	mm.	mm.	mm.
1	4.85	7.93	9.69
2	4.84	8.06	10.32
3	4.82	8.50	10.16
4	4.37	7.50	9.48
5	4.68	8.65	10.32
6	4.86	8.40	9.49
7	5.40	7.87	10.39
8	4.23	7.12	9.90
9	4.82	8.84	10.16
10	4.40	8.95	9.61
11	3.96	8.20	10.98
12	4.36	8.20	10.98
13	5.30	7.75	9.75
14	5.07	8.15	9.65
15	4.94	9.15	10.40
16	4.61	8.50	10.38
17	4.33	8.31	9.77
18	5.00	8.71	10.11
19	4.60	8.21	10.26
20	3.00	7.97	10.73
21	4.40	8.90	9.97
22	4.72	7.42	10.46
23	4.50	7.79	10.30
24	4.73	7.80	9.71
25	4.05	7.84	9.31
Total.....	114.84	204.72	252.28
Mean <sup>a</sup> .....	4.59	8.99	9.99

<sup>a</sup>L. S. M. D. = 0.23

TABLE 3

Summary of morphological and physiological characters observed in  
(Fortuna  $\times$  Wild rice)  $F_1$

CHARACTERS STUDIED	PARENTAL TYPES		(FORTUNA $\times$ WILD RICE) $F_1$
	FORTUNA	WILD RICE	
Root system:			
degree of root formation.....	poor development of branch roots and small fibrous rootlets	abundant and finely branched	poor development of branch roots and small fibrous rootlets
length.....	a mean of 14.3 cm.	a mean of 3.8 cm.	intermediate, with a mean of 13.3 cm.; more inclined to maternal parent (Fortuna)
Culm:			
number of maturing shoots.....	a mean of 9 maturing shoots	a mean of 14 maturing shoots	a mean of six maturing shoots
length.....	a mean of 87.6 cm.	a mean of 36.1 cm.	intermediate, with a mean of 82.3 cm.; more inclined to maternal parent
Leaf:			
shape.....	linear-lanceolate	linear-lanceolate	linear-lanceolate
texture.....	glabrous	glabrous	glabrous
Leaf sheaths:			
texture.....	glabrous outside	both inner and outer surfaces smooth	glabrous outside
Flower:			
anthesis.....	as early as 7:00 a.m.	as early as 6:30 a.m.	usually concurrent with maternal parent (Fortuna)
dehiscence.....	as early as 7:30 a.m. during sunny days	as early as 7:00 a.m.	usually concurrent with Fortuna
Panicle:			
rachis.....	hollow at internode, except where rachillae are borne. Rachilla is triangular.	rather fine, angled, grooved, and slightly glabrous	hollow at internode, except where rachillae were borne. Rachilla is triangular.
Caryopsis:			
breadth.....	a mean of 2.89 mm.	a mean of 1.83 mm.	intermediate, with a mean of 2.34 mm.
length.....	a mean of 9.99 mm.	a mean of 4.59 mm.	intermediate, with a mean of 8.99 mm.
shape.....	triangular to linear-lanceolate	ovate in shape	triangular to linear-lanceolate
size.....	somewhat flattened	outer glume is $\frac{1}{3}$ length of lemma	somewhat flattened
texture of the empty glume..	glabrous	coriaceous	glabrous
Germination ability:			
number of days... 4		11	intermediate, 7 days
percentage.....	87.05 per cent	12.08 per cent	intermediate, 77.0 per cent
Growth habit:			
resistance or susceptibility to drought.....	susceptible	very resistant	very susceptible

habit of straw...	erect	inclined	erect
shattering characteristics.....	nonshattering type	shattered grains easily, even at green state	nonshattering type
Pigmentation:			
leaf.....	calliste green to yellow green	grass green	calliste green to yellow green
leaf sheaths.....	yellow green to calliste green	cress green	yellow green to calliste green
empty glumes.....	ivory white	white	ivory white
lemma.....	straw-colored or ochraceous buff	blackish or ashy colored	pale ochraceous-salmon
Awn character:	awnless	long-awned	awnless
Percentage of filled grain...	98.29 per cent	50.71 per cent	16.76 per cent
Flowering.....	100 days	71 days	97 days
Maturity.....	139 days	93 days	127 days
Susceptibility to pest and diseases	susceptible to rice bug, <i>Leptocorisa acuta</i> Thunberg, and rice stem borer, <i>Schoenobius incertellus</i> Walker	very resistant to pests	very susceptible to rice bug and rice stem borer

# THE GROWTH AND HABITS OF KIDS OF PHILIPPINE GOATS<sup>1</sup>

FELIPE C. GALEON

The present study was undertaken from April, 1947, to August, 1948, in the Department of Animal Husbandry to determine the growth, development, and activities of growing kids of Philippine goats. Information of this kind will help a livestock man improve the feeding, breeding, and management of goats.

Villegas<sup>2</sup> reported that as early as three weeks of age the kids begin to nibble on feeds and that the earlier they are fed with concentrate and roughage, the better they can take care of themselves after weaning. He further mentioned that about 200 grams of grain can be consumed at one time by one goat weighing about 28 kilograms. Limpiado<sup>3</sup> found that the grade Indian kids of milking and non-milking does increased in weight up to 17 months, the largest increase taking place in the fifth month. He also obtained the greatest increase in height when they were one month old. The kids showed the greatest increase in the width of hip at the age of two months and, in non-milking does, at the age of three months.

Mendoza<sup>4</sup> found that the greatest increase in live weight of artificially raised kids was made during the first two weeks; that of the height at withers, during the first week; that of the heart girth, during the fourth week; and that of the width of hip, during the first week.

Potts and Simmons<sup>5</sup> recommend the retention of nursing kids in the herd until five months of age, and earlier weaning if raised by hand-feeding with a limited supply of milk. These authors believe that in the United States young milch does should not be bred until they are from 15 to 18 months of age, at which time they will be practically grown up if they have been well cared for. They also reported cases of milch does' kidding when less than nine months of age, which means that the first oestrus occurred when they were only about four months old.

## THE ANIMALS USED AND THE MEASUREMENTS MADE

The animals used were part of the goat herd of the Department of Animal Husbandry. There were 15 kids of native goats, seven females

<sup>1</sup>Experiment Station contribution No. 1584. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1949. Prepared in the Department of Animal Husbandry under the direction of Professor Valente Villegas.

<sup>2</sup>VILLEGAS, V. 1932. Goat raising. U. P. College of Agriculture Exper. Sta. Cir. 22.

<sup>3</sup>LIMPIADO, L. M., 1929. A comparative study of the growth and development of kids of milking and non-milking does. Philippine Agriculturist 17: 627-636.

<sup>4</sup>MENDOZA, O. C. A study on the growth, development, and feed consumption of artificially raised kids. (Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, 1948. Unpublished).

<sup>5</sup>POTTS, C. G. AND V. L. SIMMONS. 1937. Milk goats. U. S. Dept. Agric. Farmers' Bull. 9206: (Revised).

and eight males. Three of the kids died during the investigation—one of intestinal parasite, one from spaying operation, and one from unknown cause. Before the kids followed their dams to the pasture, they were allowed to play or sleep in the barn. From birth to the end of the experiment, they were never bothered in their activities.

The kids went to the pasture with the rest of the flock during the day. They grazed at seven in the morning and returned to the barn at eleven. At one in the afternoon they went back to the pasture, returned to the barn at half past three and stayed there until the following morning. The animals were not pastured on rainy days, but they were fed with soilage in the barn. Water was given at all times.

During the time that feed consumption records were being taken, each of the kids was confined in an enclosure  $30 \times 60$  cm. The soilage concentrate feed and salt were weighed and placed in separate cans. The leftovers were weighed the following morning to determine the amount consumed. The needed measurements were taken at night, once a week from birth to 56 weeks of age and biweekly thereafter until the end of the experiment.

#### RESULTS

Before any measurement was taken, the kids were made to stand squarely on their feet. The average of the three measurements during every determination was taken as the measurement for the week.

*Birth weight.* The birth weight of the male kids ranged from 1.0 kg. to 1.9 kg., with a mean of  $1.54 \pm 0.12$  kg.; whereas, that of the female kids was from 1.2 kg. to 1.9 kg., with a mean of  $1.56 \pm 0.112$  kg. The difference in birth weight of the two sexes is insignificant.

*Live weight.* The males increased in weight up to the age of 15 months. From the third to the eighth month the increase in weight was small, probably because those were the rainy months. The highest increase in weight in the male kids was registered at the age of one month, which was 15.0 per cent of the total gain in weight. The female kids continued to increase in weight until the age of 14 months. The increase in weight from the third to the tenth month was also low. The highest gain in weight was 18.58 per cent, when the female kids were one month old.

*Heart girth.* The heart girth of the male kids increased from birth to the age of 13 months, except at the age of eight months. The highest increase obtained was 24.3 per cent when they were one month old. The female kids increased in heart girth from birth to the age of 14 months. At the age of one month, they made the highest gain of 32.9 per cent.

*Height.* The male kids increased in height from birth until the age of 15 months. At the age of seven months, however, the rate of increase in height diminished. The decrease was due to two male kids which were among the tallest and were only six months old when the experiment ended. The highest increase of 30.4 per cent was made at the age of three months. The female kids continued to grow in height up to the age of 15 months. The greatest increase, 29.8 per cent, occurred during the first month.

*Length of the body.* Up to 15 months of age, the male kids continued to increase in length of body. The greatest increase of 32.9 per cent was

made at the age of one month. There was a slight decrease in the seventh month for the same reason given for the decrease in height of the male kids. The female kids continuously increased in length of body up to the age of 15 months. The highest rate of increase in length of body was 40.01 per cent, and this was noted in the first month.

*Width of hip.* The male kids continued to increase in width of hip, except in the seventh month. The greatest increase, an average of 30.6 per cent, was made in the first month. The female kids increased in width of hip up to the age of 15 months. The greatest increase, an average of 27.1 per cent, was made in the first month. The width of hip of the females from birth up to the end of the study was greater than that of the males.

*Width of shoulder.* The male kids increased in width of shoulder up to the fifteenth month, except from the sixth to the eighth month of age. The greatest increase of 41.8 per cent was made in the first month. The width of shoulder among female kids increased up to the fourteenth month, during which they also registered the greatest increase, an average of 28.9 per cent.

#### *Correlation studies*

*Between live weight and heart girth.* The live weight and heart girth showed a coefficient of correlation of 0.984. When tested for significance, the value of the computed  $t$  was 2.793 and the value of the tabulated  $t$  in a degree of freedom of 27 at 5 per cent was 2.052 and at one per cent level, 2.771. These show that the heavier the kids, the greater was the heart girth.

*Between live weight and height.* The data showed no significant positive correlation between the weight and the height of the animals. The value of  $r$  was 0.0023 and the value of the computed  $t$  was 0.012. The kids were not necessarily heavy even if they were tall.

*Between live weight and length of body.* The correlation between the live weight and the length of the body was positive and significant. The coefficient of correlation of 0.9804 and the computed  $t$  of 25.49 showed that the longer the body, the heavier was the animal.

*Between height and heart girth.* Like the weight and heart girth, there was a positive and significant correlation between the height at withers and the heart girth; the coefficient 0.798 and the calculated  $t$  6.747 indicated that the greater the heart girth, the heavier was the kid.

*Between length of body and heart girth.* There was a very high significant correlation between length of body and heart girth. The coefficient 0.988 and the computed  $t$  32.62 mean that the longer the body, the greater was the heart girth.

#### *Concentrate consumption*

As much as 98.80 grams of the concentrate were consumed by each animal a day at the third month of age, 103.70 grams at the sixth month, and 151.18 grams at the twelfth month, or a weekly consumption of 691.60 grams at the age of three months, 725.90 grams at six, and 1,058.26 grams at twelve.

*Roughage consumption*

The amount of soilage consumed by the kids, besides what they got in the pasture, increased from an average of 38.41 grams a day when the animals were just over a month old to 655.00 grams when they were about one year old.

*Salt consumption*

Each goat consumed an average of 1.50 grams of salt a day at the age of three months, 2.50 grams at six, and 5.90 grams at twelve, or a weekly consumption of 10.50 grams at the age of three months, 17.50 grams at six, and 41.30 grams at twelve.

*Age when navel cord dropped*

The navel cords of the male kids dropped when they were between the ages of 13 and 35 days, with a mean of  $18.75 \pm 2.320$  days; of the females, from 10 to 28 days, with a mean of  $21.14 \pm 1.994$  days. There was no significant difference in the age at dropping of the navel cord between the two sexes. Of the kids studied, 53.3 per cent dropped their navel cords when they were between 10 to 20 days old, 40.0 per cent when 21 to 30 days old, and 6.60 per cent when over 30 days old.

*Age when kids started to follow their dams to the pasture*

The kids started to follow their dams to the pasture when they were between the ages of 13 and 25 days, or a mean of  $16.46 \pm 0.928$  days. Before this age the kids were not strong enough. Of the kids that followed their dams to the pasture, 86.6 per cent were between 13 and 20 days old, and 13.1 per cent were between 21 and 25 days old. There was no significant difference between the two sexes in the mean age when the kids started to follow their dams to the pasture.

*Age when the horns appeared*

The horns of the kids appeared when the animals were from 17 days to 32 days old, or a mean of  $23.80 \pm 1.17$  days. There were 26.6 per cent of the kids that had their horns out before they were 20 days old; 60.0 per cent, between the ages of 21 and 30 days; and 6.6 per cent beyond 30 days of age. There was no significant difference in the ages of both sexes when the horns broke through the skin.

*Age when kids started to nibble on feeds*

*Roughage.* In all instances, the kids started feeding on roughage earlier than they did on concentrate and salt. The kids started to nibble on roughage from the age of 16 days to 32 days; the mean was  $22.26 \pm 1.18$  days. Sixty per cent of the kids started to eat roughage between 20 and 30 days of age, 33.3 per cent between the ages of 16 and 20 days, and only 6.6 per cent when over 30 days. There was no significant difference in the mean ages of both sexes when the kids started to take in roughage.

*Concentrate.* The kids started to feed on concentrate when they were between 30 and 42 days old; the mean was  $34.06 \pm 0.835$  days. Of the 15 kids, 13.3 per cent began to take in concentrate when they were 30 days old; 66.6 per cent, when they were between 31 and 35 days; and 20 per cent, when they were between 36 and 42 days old. There was no significant difference between the mean ages of both sexes when they started to take in concentrate.

*Salt.* The young animals began to eat salt 10 to 25 days after they had learned to feed on roughage. The mean age when the kids started to take in salt was  $42.35 \pm 1.307$  days. They did not start to take in salt until they were between 35 and 52 days old. Of the 14 kids that took salt, 35.7 per cent started to take it when they were 35 to 40 days old, 57.1 per cent when 41 to 50 days old, and 7.1 per cent when over 50 days old. There was no significant difference in the mean ages of both sexes when the animals started taking in salt.

#### *Weaning*

The weaning age ranged from 145 days to 250 days, with a mean of  $190 \pm 10.78$  days. Sixty per cent of the animals were weaned when they were between the ages of 145 and 200 days, and 40 per cent when over 200 days old. The difference in the weaning age of both sexes was not significant.

Although the kids sucked less frequently as they grew older, they were not completely weaned until the dams refused to be sucked.

#### *Age of male goats at first mounting and at first copulation*

The male goats started to mount from 120 to 229 days of age, or a mean age of  $155.85 \pm 13.04$  days. There were 57.1 per cent of the male goats which mounted for the first time between the ages of 120 to 150 days; 28.5 per cent, between 150 to 200 days; and 14.2 per cent, over 200 days old.

The males effected first copulation from the age of 137 days to 245 days, or a mean of  $174.28 \pm 14.98$  days. First copulation was effected in 3 to 53 days after the first mounting. It seems that the time elapsing between the first mounting and the first successful copulation was due to factors other than sexual maturity of the males. The male goats were sexually mature when they began to mount the females; they were about five months of age, on the average.

#### *Age of young does at time of first mating and fertilization*

The female goats did not allow the males to mate with them before they were 156 days old. All females had been mated when they were 401 days old. The mean age of the females at mating was  $229.5 \pm 35.48$  days. Of the goats which mated for the first time, 35.3 per cent mated when they were from 136 to 200 days old, 50.0 per cent when 200 to 300 days old, and 16.6 per cent when 401 days old.

Arriola<sup>6</sup> found the gestation period in goats to be 148 days. Based on this figure, the computed age of the does at impregnation or fertilization of the ovum was from 223 to 395 days, or a mean of  $291.5 \pm 31.92$  days. Of the goats which mated, 75 per cent were impregnated between the ages of 223 and 286 days, and 25 per cent when they were 395 days old.

*Age of does at first kidding*

Four does delivered during the experiment. The age at first kidding ranged from 371 to 543 days, or an average of 439.75 days. There were 25 per cent of the does which kidded at the age of 371 days, 50 per cent from 400 to 500 days, and 25 per cent when they were 543 days old.

SUMMARY

1. The male kids increased in weight up to the fifteenth month of age and the female kids, to the fourteenth. In both males and females the highest increase occurred at the age of one month.

The highest rate of increase in heart girth, height at withers, length of body, width between points of hip, and width between points of shoulder in both sexes took place at the age of one month. The width between points of hip was consistently greater in the females than in the males.

2. Positive correlation existed between live weight and heart girth, live weight and length of body, length of body and heart girth, and height at withers and heart girth. There was no correlation between the live weight and height.

3. The kids started to take concentrate at a mean age of  $34.06 \pm 0.835$  days; to eat soilage, at the mean age of  $22.26 \pm 1.18$  days; and to lick salt at a mean age of  $42.35 \pm 1.307$  days.

4. The navel cord dropped at the mean age of  $18.75 \pm 2.320$  days for the male kids and  $21.14 \pm 1.994$  days for the female kids.

5. The male kids followed their dams to the pasture at the mean age of  $16.50 \pm 1.274$  days and the females, at  $16.42 \pm 1.357$  days.

6. The horns of the male kids appeared at the mean age of  $22.25 \pm 1.395$  days and of the female kids, at  $25.57 \pm 1.70$  days. The mean age at weaning was  $190.00 \pm 10.78$  days. The male goats mounted for the first time at the mean age of  $155.85 \pm 13.04$  days; the first copulation took place at the mean age of  $174.28 \pm 14.98$  days. The mean age of the young does at first mating was  $229.5 \pm 35.48$  days and at first impregnation,  $291.5 \pm 31.92$  days. The mean age at first kidding was  $439.75 \pm 31.86$  days.

<sup>6</sup>ARRIOLA, G. C. 1936. A study on the breeding habits of goats. *Philippine Agriculturist* 25: 11-29.

# COPRA MEAL IN A RATION FOR GROWING DUCKLINGS<sup>1,2</sup>

ADOLFO M. LIOANAG

Fronza and Basio (1938)<sup>3</sup> used copra meal and shrimp meal in various amounts as protein supplement in rations for laying ducks and observed that copra meal did not improve egg production. They claimed that local duck raisers do not add copra meal to the rations because its oil stimulates the deposition of fat rather than increase the production of eggs. In order to determine the effects of the addition of copra meal to a ration for growing ducklings, these experiments were conducted from May, 1947, to January, 1948, in the Department of Animal Husbandry.

## PLAN OF THE STUDY

Three hundred four-day-old male Mallard ducklings were used in this study. There were two replications, each covering a period of 11 weeks. The 150 ducklings used in the first set were bought in Pateros, Rizal, and the 150 ducklings used in the second were bought in Cabuyao, Laguna.

The ducklings in each set were legbanded and then divided into two lots of 75 birds each. Those in lot I served as control; those in lot II had copra meal in their ration. They were housed in fireless brooding pens; each pen was covered with a thick litter of rice hulls and provided with a small run where the ducklings could expose themselves to the morning sun.

The two lots were given identical rations, except that one half of what should be shrimp meal was replaced with copra meal in the ration given to lot II. The rations, all parts by weight, for the two lots were as follows:

INGREDIENTS	LOT I	LOT II
Fine rice bran.....	60	60
Ground corn.....	20	20
Shrimp meal.....	20	10
Copra meal.....	—	10

In both lots, finely chopped green feed was mixed with the ration which was given as sloppy mash four times a day. The ducklings were fed at 6 A.M., 10 A.M., 2 P.M., and 6 P.M. The feed was given in shallow feeding troughs 30 cm. by 100 cm. At each feeding, the ducklings were given as much feed as they could readily consume. They had free access to clean drinking water placed in a separate bamboo trough constructed such that the ducklings could not bathe themselves in it.

<sup>1</sup>Experiment Station Contribution No. 1585. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, 1948. Prepared in the Department of Animal Husbandry under the direction of Professor F. M. Fronza.

<sup>2</sup>Part of the expenses incurred in this study was paid from a research grant by the National Research Council of the Philippines.

<sup>3</sup>FRONZA, F. M., AND ENGRACIO BASIO. 1938. The use of copra meal in duck rations for egg production. *Philippine Agriculturist* 27: 173-176.

Records of the initial and weekly individual weights, the amount of feed consumed, the mortality, and the returns from the sales of ducklings were kept.

#### RESULTS AND DISCUSSION

##### *Rate of growth of ducklings*

The weights of the ducklings at weekly intervals were used as the criteria in determining the effects of copra meal on the rate of growth of the ducklings. These weights have been summarized in table 1. The average weekly weights of the ducklings in the two sets showed that both replications apparently gave similar results. There was not much difference in the initial weights of the ducklings in both lots. In the first set, the initial average weight of each bird in lot I was  $43.9 \pm 0.69$  grams and in lot II,  $45.8 \pm 0.70$  grams; and in the second set,  $41.5 \pm 0.60$  grams in lot I and  $41.6 \pm 0.57$  grams in lot II. The average initial weights of both sets were  $42.7 \pm 0.64$  grams in lot I (control) and  $43.7 \pm 0.63$  grams in lot II (with copra meal). At the end of the second week, the ducklings in lot I had more than doubled their initial weights. The ducklings in lot II, on the other hand, had consistently lower average weight than those of lot I from the first week to the close of the experiment in both replications. This result showed that the addition of copra meal in the feed tended to retard the growth of the ducklings.

In the first set, the average weekly gain in weight of the ducklings was 66.8 grams for each bird in lot I and 52.1 grams for each bird in lot II; in the second set, lot I had an average weekly gain in weight of 70.9 grams a bird, whereas lot II had only 50.7 grams a bird. When the gains in weight of the ducklings in the two lots in both sets were compared statistically, those in lot I were found to have gained significantly more in weight than those in lot II. At the end of the eleventh week, the mean weight for the first set was  $779.0 \pm 31.0$  grams in lot I and only  $589.0 \pm 26.0$  grams in lot II, with a significant difference of  $190.0 \pm 40.4$  grams in favor of lot I. In the second set, the mean weights of the ducklings were  $822.2 \pm 35.5$  grams in lot I and only  $600.0 \pm 45.0$  grams in lot II. The difference in weight was also significantly in favor of lot I.

##### *Feed consumption and cost*

The amount and cost of feed consumed by the ducklings in the two sets of the experiment, computed on the basis of 100 birds, are shown in table 2. The costs of the two rations, based on current prices, were 27.2 centavos a kilogram in lot I and 21.7 centavos in lot II.

Table 2 shows that in the first set of the experiment, the ducklings in lot I consumed 442.5 kg. of feed for every 100 birds in 11 weeks, while those in lot II consumed only 256.6 kg. for every 100 birds. In the second set, the ducklings in lot II consumed only 298.6 kg. The two sets had a combined average consumption of 435.6 kg. of feed for the 100 birds in lot I and only 277.8 kg. in lot II. Apparently, the ducklings that received copra meal in their ration consumed much less feed than those that received the ration without it. The lower feed consumption by the ducklings in lot II may be partly attributed to the unpalatability of copra meal and partly to the smaller size of the birds in this lot.

At the close of the experiment, the ducklings in lot I of the first set consumed 442.5 kg. of feed to gain 73.51 kg. in weight, or 6.02 kg. of feed for every kilogram gain in weight. On the other hand, those in lot II consumed 256.6 kg. of feed to gain 57.26 kg. in weight, or 4.72 kg. of feed for each kilogram gain in weight. In the second set, the ducklings in lot I consumed 428.7 kg. of feed to gain 78.08 kg. in weight (5.49 kg. of feed for each kilogram gain in weight), while those in lot II consumed 298.6 kg. to gain 55.84 kg. in weight (5.35 kg. of feed for each kilogram gain in weight). The ducklings in lot I of both sets consumed an average of 5.76 kg. of feed for every kilogram gain in weight, whereas those in lot II consumed only 5.04 kg.

Table 2 also shows the value of the gain in weight minus the cost of the feed. The ducklings were sold at ₱1.50 a kilogram live weight. Based on the averages of the two sets at the close of the experiment, the ducklings in lot I had a net loss of 7 centavos, whereas those in lot II had a net gain of 40 centavos for every kilogram of weight produced. From the point of view of loss and gain in the operation, therefore, the use of copra meal is advantageous despite its apparent retarding effect on the growth of the ducklings; it reduced the cost of feed necessary to produce a kilogram gain in weight.

#### *Mortality*

The mortality in the first trial was 30.66 per cent in both lots. In the second trial, however, the mortality was 30.66 per cent in lot I and 42.66 per cent in lot II. The heaviest mortality occurred during the first week in all lots in both sets. Two ducklings in lot I died of suffocation during the ninth week of the first set. Scared by the presence of man, the ducklings crowded in a corner where some of them, especially the small ones, were suffocated. This rather high rate of mortality in both lots undoubtedly influenced the gain obtained in the operation.

#### SUMMARY

1. Copra meal in the ration for growing male ducklings tended to retard their growth.
2. Significant differences in weights, which showed the superiority of the ducklings in the control lot over those in the lot fed with copra meal, were noted from the fourth week to the end of the experiment.
3. The ducklings with copra meal in their ration consumed much less feed than those without it.
4. The amount of feed needed for every kilogram gain in live weight at the close of the experiment was 5.76 kg. for the control lot and 5.04 kg. for the lot that received copra meal in its ration.
5. The lot given copra meal was financially more desirable than the control lot because its feed was cheaper.
6. There was no appreciable difference in the mortality of the birds in both lots.

TABLE 1  
*Average weights of the ducklings*

AGE IN WEEKS	LOT I		LOT II	
	First set	Second set	First set	Second set
	grams	grams	grams	grams
Initial (4 days).....	43.9± 0.69	41.5± 0.60	45.8± 0.70	41.6± 0.57
Final (11 weeks).....	779.0± 31.0	822.2± 31.0	589.0± 26.0	600.0± 27.76

TABLE 2  
*Returns above the cost of feed*

ITEMS	LOT I		LOT II	
	First set	Second set	First set	Second set
Total gain in weight, kg.....	73.51	78.08	57.26	55.84
Value of gain in weight, pesos <sup>a</sup> .....	110.28	117.13	85.91	83.78
Feed consumed, kg.....	442.5	428.7	256.6	298.6
Cost of feed consumed, pesos <sup>b</sup> .....	129.36	116.62	55.68	68.80
Value of gain less cost of feed, pesos.....	-10.08	0.51	30.51	18.98

<sup>a</sup> Computed at P1.50 a kg. live weight.

<sup>b</sup> Computed at P0.272 a kg. for lot I and at P0.217 for lot II.

## THE GROWTH AND ACTIVITIES OF SUCKLING CALVES<sup>1</sup>

DEMETRIO M. CABANTAC

The most rapid growth of calves takes place during the suckling period. Mead (1942)<sup>2</sup> noted that the normal calf usually stands and attempts to nurse itself within an hour after birth. Usually after 36 to 48 hours, the calf will have received sufficient amount of the first milk and may be removed from the dam if it is a dairy calf. Regardless of the feeding method used, a vigorous calf usually receives milk during the first two weeks of its life.

The growth, development, and habits of eight calves, three males and five females, were studied in the Department of Animal Husbandry from December, 1948, to December, 1949. They were half native and half Nellore. A native, a half Native and half Red Sindhi, and a grade Hereford were also observed.

### WEIGHTS AND MEASUREMENTS TAKEN

The calves were measured and weighed at birth and weekly thereafter until they were weaned. They were measured as they stood squarely on their four legs. The height was taken by measuring the perpendicular distance from the floor to the top of the withers. The length of the body was measured with a wooden caliper from the point of the shoulder to the pin bone. The heart girth was determined by putting the tape around the chest just behind the shoulder of the calf. The depth of the chest was measured where the heart girth was taken by placing the wooden caliper perpendicularly from the bottom of the chest to the back.

### RESULTS

*Birth weight.* The weights at birth of the half-Nellore-half-Native calves ranged from 17.0 to 25.0 kilograms, or a mean of  $20.94 \pm 1.01$  kilograms. This mean is 2.32 kilograms higher than the mean weight at birth of Philippine calves, but 2.98 kilograms lower than that of Nellore calves (Villegas, 1931)<sup>3</sup>. This author found that the mean weight at birth of native Philippine calves was  $18.62 \pm 0.56$  kilograms and that of Nellore calves,  $23.92 \pm 0.26$  kilograms.

*Weight.* The biweekly weights increased progressively from birth. From 14 to 16 weeks of age the mean weight was 400 per cent; from 28 to 30

<sup>1</sup>Experiment Station Contribution No. 1586. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1950. Prepared in the Department of Animal Husbandry under the direction of Professor Valente Villegas.

<sup>2</sup>MEAD, S. W. 1942. Raising dairy calves in California. California Agric. Ext. Serv. Cir. 107. (Revised)

<sup>3</sup>VILLEGAS, V. 1939. The birth weights of horses, cattle, and carabaos and their relation to the weights of dams. Philippine Agriculturist 28: 253-259.

weeks, 700 per cent; and at 46 weeks, over 800 per cent. The gain in weight from one period to another tended to decrease as the calves grew older. The total gain in weight at 46 weeks of age was 145.76 kilograms.

*Height.* The mean height of the calves at birth was  $62.21 \pm 1.73$  centimeters. The height at birth considered as 100 per cent, the height at the age of 28 weeks was 158.9 per cent and at 46 weeks, 168.3 per cent. The total increase in height at 46 weeks of age was 42.49 centimeters. The rate of increase in height was greater when the animals were young.

*Length of body.* The mean length of the body of the calves at birth was  $53.50 \pm 1.53$  centimeters. At the age of 28 weeks, the length of the body was 176.7 per cent of that at birth and at 46 weeks of age, 193.6 per cent. A total of 50.10 centimeters gain was made by the calves from birth up to 46 weeks of age. The rate of increase was higher at early age than later.

*Heart girth.* The mean heart girth of the calves at birth was  $63.64 \pm 1.14$  centimeters. At 28 weeks of age the heart girth was 185.9 per cent of that at birth and 199.7 per cent at 46 weeks of age. The total increase at the end of the experiment was 63.96 centimeters, the rate of increase being greater when the animals were younger.

*Depth of chest.* The mean depth of chest of the calves at birth was  $22.43 \pm 0.62$  centimeters. The depth of chest at 28 weeks of age was 194.3 per cent of that at birth and 215.3 per cent at 46 weeks of age. The total gain in depth of chest at the end of the observation was 25.87 centimeters. The rate of gain in each period was higher when the calves were young than when they were old.

*Frequency and duration of sucking.* The frequency of sucking of calves one to 15 days old observed at daytime ranged from two to nine times in a 12-hour period, the average duration ranging from 10 to 15 minutes. The lone calf observed at night time within this age sucked twice, with an average duration of 18 minutes. At 91 to 105 days of age, the frequency of sucking during the day was from two to five times, lasting from 10 to 12 minutes. At night the calf at this age sucked twice for 10 minutes. Of the six calves observed at daytime at the age of 196 to 210 days, five sucked once and one twice. The average length of sucking was 5 to 10 minutes. At night three calves sucked twice and the other three once; the average duration ranged from 6 to 10 minutes. Only two calves sucked when they were 286 to 300 days of age. One sucked once at daytime, but both sucked once at night, the duration being from 4 to 9 minutes.

*Frequency and duration of rumination.* At one to 15 days of age, the calves ruminated three times in 5 minutes. The calves which did not ruminate at this age were not yet nibbling on the forage. At the age of 91 to 105 days, the animals ruminated four to seven times in 14 to 46 minutes. The calf observed at night at this age ruminated three times for 26 minutes. At the age of 196 to 210 days, the frequency of rumination was four to seven times at daytime and three to eight times at night. During the day they ruminated for 19 to 42 minutes and at night for 25 to 35 minutes. The frequency of rumination at the age of 286 to 300 days was two to six times during the day. The rumination was 15 to 25 minutes at daytime and 16 to 34 minutes at night.

*Lying-down position.* The calves one to 15 days old lay down eight to twelve times at daytime for as long as 36 to 55 minutes; the calf at this age

lay down six times at night for a total of 98 minutes. At 91 to 105 days of age, the calves lay down five to ten times in 28 to 43 minutes. A calf of the same age lay down five times for a total of 128 minutes at night. At 196 to 210 days of age they lay down four to eleven times at daytime from 13 to 61 minutes, and four to ten times at night from 44 to 127 minutes. At the age of 286 to 300 days, they lay down two to four times in the day from 19 to 38 minutes, and two to five times at night from 105 to 191 minutes. The frequency of lying down at daytime or at night did not vary much, although the calves lay much longer at night than during the day.

*Frequency of defecation and urination.* During the whole period of the experiment, the calves defecated from one to seven times during the day and four times at night. The frequency of urination was from one to six times in the day and three times at night. Although defecation and urination were more often and regular at daytime than at night, the frequency at different periods did not vary.

*Age at first nibbling on forage.* Blueda, the youngest calf, began nibbling on forage when six days old and Marinda, the oldest, when 14 days old. The calves started to nibble on forage at the average age of nine days.

*Age at first mounting.* Bonblue, a male calf, attempted to mount as early as 24 days of age; Marinda, female, was the latest to do so at the age of 112 days. The calves first mounted at an average age of 69.5 days. All the calves, regardless of sex, were observed to mount, except Bulova, which was still very young. No mating was observed at this time.

*Age at weaning.* Mablu was the youngest calf to be weaned, it being about 8 months old only, and Blueluto, about 10 months old, was the oldest. The average age of all the calves at weaning time was 277.6 days, or about 9 months. In all cases, weaning was due to the mothers' refusal to be sucked. There was no instance when the calf weaned itself from its dam.

#### SUMMARY

1. The rate of increase in weight, height, length of body, heart girth, and depth of chest was greater when the eight Nellore-Philippine crossbred calves studied, were young than when they were old, the decline having become noticeable when they were about 32 to 34 weeks of age.

2. As the calves became older, the frequency and duration of sucking decreased. They sucked from 4 to 18 minutes, nine times during the day and three times at night.

3. There were no appreciable changes in the frequency and duration of rumination of the calves during the sucking period. They ruminated as often as eight times in the day and twelve times at night, the duration varying from 3 to 41 minutes. The calves lay down from two to twelve times in the day and one to eleven times at night, the duration being 13 to 192 minutes. They lay down generally very much longer at night than at daytime. They defecated one to seven times at daytime and four times at night. They urinated as often as six times during the day and three times at night.

4. The calves started to nibble on forage at an average age of nine days, although they were weaned after 277.6 days, on the average. They began to mount without mating at an average age of 69.5 days.

## ORGANIZATION AND OPERATION OF COÖPERATIVES IN THE PHILIPPINES<sup>1</sup>

N. B. TABLANTE AND O. G. SANTOS<sup>2</sup>  
*Of the Department of Agricultural Economics*

A knowledge of the working of different types of coöperative associations is necessary for a fuller appreciation of the merits of coöperation.

Mabbun (1927) reported only two coöperative marketing associations in operation in 1924, organized by the tobacco growers in the Cagayan Valley. The same author (1929) found that the rural coöperative credit associations organized in 547 municipalities all over the Philippines had a total membership of more than 80,000 and a total capital of over ₱2,500,000, all of which was actually loaned to members.

Of 67 agricultural coöperative credit associations in Panay whose membership totaled 10,753, Arnaldo (1931) concluded that the system of farm credit in the Philippines was far from being satisfactory. He recommended a general revision and complete overhauling of the rural credit law (Act No. 2508).

At the close of 1932, there were incorporated with the Bureau of Commerce 80 coöperative marketing associations, but only 46 actively dealt in tobacco, rice, sugar, abacá, copra, and nipa vinegar, and had an aggregate volume of business of ₱2,581,000. At the close of 1935, there were 105 such associations registered, but only 45 of these were in active business (Mabbun, 1937). In 1935, Mabbun hinted that the prospect of the tobacco industry in the Cagayan Valley depended upon the organization of local coöperative marketing associations which would federate gradually into municipal organizations, and later, into a central organization under some plan, as that of the California Fruit Growers' Exchange.

The National Coöperatives and Small Business Corporation<sup>3</sup> reported that 571 agricultural credit coöperative associations had been organized up to 1939. A good number of these stopped operating, and others remained dormant, primarily because of mismanagement. In the same year, there were also 160 coöperative marketing associations with a total membership of about 5,000 farmers. Only 33 associations, however, reported their sales of farm products aggregating to ₱5,529,059, to the Bureau of Commerce. This same office also reported that as of 1948, there were 528 operating coöperatives in the Philippines, with 120,230 families as members and a total paid-up capital of ₱1,346,413.<sup>4</sup>

<sup>1</sup>Experiment Station Contribution No. 1589. Based on the thesis presented for graduation of the junior author with the degree of Bachelor of Science in Agriculture from the College of Agriculture, November, 1950. Prepared in the Department of Agricultural Economics under the direction of the senior author.

<sup>2</sup>At present with the National Power Corporation, Manila.

<sup>3</sup>Recently reorganized as the Coöperatives Administration Office, Department of Commerce and Industry. In this paper, the name National Coöperatives and Small Business Corporation refers to this office.

<sup>4</sup>Anon. Primer on coöperatives and credit unions. 3rd printing (1948). 118 p. Manila: National Coöperatives and Small Business Corporation.

This study was made in Manila and neighboring towns, and in the Department of Agricultural Economics of this College from December, 1949, to October, 1950, to understand such economic aspects as method of organization, business operations, and management policies of different types of coöperatives in the Philippines, and to discover the weak and the strong points of coöperation as a business venture.

#### MATERIALS AND PROCEDURE

Most of the data used in this investigation were gathered from the reports of coöperatives all over the Philippines submitted to the central office of the National Coöperatives and Small Business Corporation in Manila. All coöperative associations in this country are under the supervision of this agency and are required to file their reports with it in accordance with the provisions of Section 5 of Commonwealth Act No. 565, as amended by Commonwealth Act No. 713, and with Section 4 of Executive Order No. 322. Information was asked on type and location of coöperative, volume of business, present status, membership, and capital. An analysis of the business of the 54 coöperatives distributed in different parts of the country, which were the only ones that submitted their financial and operating statements to the NCSBC, was made. Twenty-seven coöperatives in Manila and 24 associations in the neighboring towns were surveyed in order to supplement the data obtained from the files of NCSBC.

#### DISCUSSION

*Number of associations.* As of June 30, 1949, there were 1,367 coöperative associations registered with the National Cooperatives and Small Business Corporation. Of this number, 975, or 71 per cent, were consumers' associations; 261, or 19 per cent, producers' associations; 83, or 6 per cent, retailers' coöperatives; and 48, or 4 per cent, other associations consisting of 27 credit unions, 17 coöperative marketing associations, and 4 industrial coöperatives. Of the total number of incorporated associations in the Philippines, 961, or 70 per cent, were inactive. In some provinces, like Abra and Cagayan, which had 14 registered coöperatives each, not even one was in operation.

Manila had the largest number of registered coöperatives, 326, or about one fourth of the total number of associations in the country. Most of these were of the consumer type. Nueva Ecija had the most number of producers' coöperative associations, while Laguna ranked first in the number of credit unions. The provinces of Davao, Lanao, Misamis Occidental, and Palawan had only one association each. Agusan, Batanes, Sulu, and the subprovince of Siquijor reported that no association had yet been organized as of June 30, 1949.

From July 1, 1946 to December 7, 1949, there were registered 39 new coöperative associations of different types, thus making the total number 1,406. Only 445, or slightly less than one third of the total number registered, were active; the rest were either dormant or had ceased operations.

*Membership.* The aggregate membership of the 1,367 registered associations was 260,134. The average number of members of all types of association in all provinces was 190. The minimum membership of 15, as

required by law, was reported in the provinces of Palawan and Samar. The largest membership recorded, 357, was in the province of Camarines Sur. The average membership for each type of coöperative association was 177 for consumers', 157 for producers', 33 for credit unions, 52 for retailers', 33 for industrial, and 38 for coöperative marketing associations. Some were members of more than one type of association, hence, it was difficult to eliminate duplication of members when counting the total membership in a given area.

Both the rich and the poor, regardless of political or religious affiliation, may become members of an association by buying shares of stock which usually cost five pesos a share. This practice is in conformity with the coöperative principle of open and voluntary membership. It has been observed, however, that the typical coöperative membership is drawn largely from laborers, employees, school teachers, and small farmers.

*Authorized and paid-up capital.* The total authorized capital of all registered coöperative associations in the Philippines was ₱30,439,981, averaging ₱22,268 for each association. All of the 1,367 coöperatives aggregated a paid-up capital of ₱3,398,213, or an average of ₱2,485 for each coöperative, which was approximately 10 per cent of the total amount authorized. The average paid-up capital for each association ranged from ₱651 as reported in the province of Negros Oriental, to ₱12,875 in the province of Nueva Vizcaya. The average authorized capital ranged from ₱4,500 in the Mountain Province to ₱100,000 in Davao.

The average paid-up capital for each type of coöperative was ₱2,219 for consumers', ₱2,462 for producers', ₱1,106 for credit unions, ₱3,572 for retailers', ₱1,000 for industrial, and ₱2,735 for coöperative marketing associations.

*Financial status.* The combined total assets of the 54 active associations located in various parts of the country which submitted their 1949 statements to the NCSBC amounted to ₱1,547,067, or an average of ₱28,649 for each association. As revealed by the consolidated balance sheet of these associations, fixed assets, such as buildings, equipment, and land, made up slightly one third of total assets, and current assets represented about two thirds. Current assets consist of cash, inventories, notes receivable, and accounts receivable, although it is quite questionable to class all receivables as current assets, since their collectivity is doubtful.

Total liabilities amounted to ₱499,276, or an average of ₱9,246 for each association, and were equal to 32 per cent of total equities. Of these liabilities, 92 per cent were classed as current, and the remainder as long-term obligations.

The net worth of an association represents the value of the property interest of its members. The total net worth of the 54 associations was ₱1,047,790, averaging ₱19,403 for each association, and was equal to 68 per cent of the total equities. The average capital stock was ₱13,504, or nearly 70 per cent, and surplus, ₱5,900, or about 30 per cent of the net worth. The paid-up and outstanding capital stock was slightly less than one half of the total assets.

The 54 coöperative associations were grouped at ranges with intervals of one thousand according to the value of paid-up and outstanding capital

stock. One fourth of these coöperatives had capitals of more than ₱8,000, averaging ₱43,000 for each association, and about 30 per cent had less than ₱2,000. The smallest amount of paid-up capital, ₱142, was reported by the Bulacan High School Cooperative Association in Malolos, Bulacan, and the largest, ₱169,539, by the Ilocos Norte Farmers' Association. The Manila Railroad Company Coöperative Association trailed closely with ₱160,772.

The value of total assets ranged from ₱684 (Bulacan High School Coöperative) to ₱412,326 (Manila Railroad Coöperative). Twenty-three associations, or about 43 per cent, had total assets not exceeding ₱5,000, or an average of ₱2,862. Nine associations had more than ₱25,000 worth of assets.

The financial status of coöperatives may also be determined on the basis of net capital ratio, or the relationship between the total assets and the total liabilities. Fifteen per cent of the associations had liabilities of more than 40 per cent of all assets. More than two thirds, however, had total liabilities below 20 per cent of total assets; included among these were 11 associations without any liabilities. No association reported any case wherein the total liabilities exceeded the total assets. The average total liabilities, 32 per cent, were sufficiently low in relation to the total assets. This suggests that the financial status of Philippine coöperatives was relatively sound in 1949.

Financial conditions expressed as ratios between different items set up in the balance sheet indicate the relative stability of a business for a given period. The current ratio, which is computed by dividing the value of the current assets by that of the current liabilities, is one of the financial yardsticks frequently used by many business concerns to indicate the status of the current working capital of the business. Bakken and Schaars (1937) stated that roughly an association is considered in good liquid position if the current ratio is 2:1. The greater this ratio is, the more free the current assets are from debts. Ten of the 54 associations fell below this arbitrary standard of current solvency because they averaged only about one peso and fifty centavos of current assets to a peso of current liabilities. Two associations had current liabilities exceeding current assets, and were not in a position to meet all obligations as of 1949. Thirty-one associations had a very much higher working capital than current obligations; 20 of these associations had an average ratio of 36:1 and 11 associations had no current liabilities. On the whole, the average current ratio was equal to the standard 2:1 ratio.

The members' equity in the business is used to measure the financial soundness of a business entity on the basis of its ultimate solvency, or its ability to liquidate its long-time maturing obligations. This is interpreted as the relation of total net worth to total assets. It also indicates the degree to which members control their business financially. In general, a ratio of 50 per cent total net worth to total assets is considered a desirable minimum. Four associations had less than this recommended ratio, averaging only 40 per cent, or 40 centavos net worth for a peso of total assets. The modal group ranged from 50 to 99 per cent, or an average of 84 per cent. For the whole group, the average was 67 per cent, which is better than the

desirable ratio for members' equity established in the United States (Poffenberger, Ives, and DeVault, 1941).

The board of directors of an association does not usually pay out a part of the profit to members. This amount retained in the business is called surplus or undivided profits. The amount of surplus for every peso of capital stock, or surplus ratio, indicates the extent to which reserves are set aside for contingencies. Seven coöperatives had negative surplus (deficits), 18 associations had surplus ratios less than 25 per cent, and a similar number had more than a 1:1 ratio of surplus to paid-up and outstanding capital. On the average, there was a surplus of 44 centavos for every peso of capital stock.

*Operating results.* A report in 1949 of the consolidated profit-and-loss statement of 53 different coöperatives showed that the aggregate volume of sales amounted to ₱4,666,622 and averaged ₱86,419 for each association. Operating expenses were 15 per cent of sales, or 79 per cent of the gross profit. Net profits amounted to ₱202,903, or an average of ₱3,757 for each association. This was 4 per cent of the volume of business, or more than one fifth of the gross margin. The amount of purchases plus the value of the difference between the opening and closing inventories gives the cost of goods sold. The cost of goods sold subtracted from the total sales gives the gross margin. Gross profit averaged 19 per cent of the volume of sales.

The efficiency of operation of an association may be measured by the operation ratio, which is expressed as a proportion of the total operating expenses to the total volume of business for the year. About 59 per cent of the associations had operating expenses of less than 10 per cent of the total sales. The ratio was considerably high for some cooperatives due to the small volume of business. The Pura Farmers' Coöperative Association of Pura, Tarlae, for example, had an operation ratio of 49:1 because the total sales amounted to only ₱67.05, whereas the operating expenses were ₱3,287.14. The average operation ratio of all associations was 15 per cent, that is, an average of 15 centavos of operating expenses for every peso of sales.

Nine of the associations studied suffered an average loss of ₱1,495 in 1949. The Rural Producers-Consumers Coöperative Association of Laoag, Ilocos Norte, sustained the greatest individual loss, ₱4,650. Nineteen associations made a net profit of less than ₱1,000, averaging ₱369 each and eleven a net profit of more than ₱5,000, averaging ₱16,604 each. The largest net profit for the year was reported by the U. S. T. Coöperative Association, ₱47,395. The average net gain for all cooperatives was ₱3,902.

Twenty-one associations, or 40 per cent of the total number, reported a net profit of less than 5 per cent of sales; 12 associations, or 23 per cent, a net profit of 5 to 10 per cent; and 4 associations, or 8 per cent, a net profit of more than 20 per cent of total sales. The average net profit of all associations was 4 centavos for every peso of sales. Many farmers' coöperatives made very small net profits; some even sustained losses.

As of October, 1949, the 74 credit unions reported by the NCSBC had a total membership of 5,522, or an average of 76 members for each association. Since their organization, a total of 4,429 loans amounting to

P559,537—an average of P7,561 for each association or an average of P127 a loan—have been made. In total amount of loans, the Silliman University Credit Union ranked first, P91,136. Its present loans amount to P39,074. Since its organization, it has made 187 loans, about one half of which are represented by present loans. The present value of shares is P44,885, and the total membership is 197. The Batac Community Credit Union, with 670 members and a total of 612 loans in 1946, ranked highest in number of members and in total number of loans.

Membership in a credit union is generally limited to a closely related group because the operation of the association is principally based on character. Loans are granted to members for provident or productive purposes only. A providential loan is one which helps a member-borrower in an unexpected emergency; while a productive loan is one which aids a member to save part of his earnings or increase his savings through the wise use of credit. Loans bear an interest of 12 per cent per annum on the unpaid diminishing balance. Loans up to P50 are granted without any security; the good character of the borrower and the signature of at least one witness are the only requisites.

*Distribution of savings.* The savings of a coöperative association, particularly of the consumer type, is the resultant amount after the total operating expenses have been subtracted from the gross margin. These savings are distributed periodically to all patron members, and sometimes, even to nonmembers who patronize the business, in proportion to their patronage. From the net profits of the association is deducted the interest on capital, which shall not exceed a rate of 8 per cent per annum, as required by Section 3 of Commonwealth Act No. 565. The difference is then divided, in accordance with Article IX of the model by-laws prescribed by the NCSBC for coöperatives, as follows: 50 per cent for the amortization of the outstanding indebtedness of the association (in the absence of any indebtedness then outstanding in the name of the association, this amount is also distributed as patronage refunds in addition to the 25 per cent allotted for the purpose); 20 per cent for augmenting the working capital; 5 per cent for educational, publicity, or supervisory purposes; and 25 per cent to be distributed as patronage dividends to the members. To find the percentage that should be declared as patronage refund, the total amount available for the purpose is divided by the total sales for the year.

*Management.* Management consists of the control and direction of the activities of an organization. In the case of cooperative associations, this is a three-way relationship involving the members, the board of directors, and the manager. A coöperative organization is managed and operated by the members through powers delegated to a board of directors consisting of five to eleven members elected for a term of one year. The board in turn employs a manager vested with the power and obligation of effecting the broad policies prescribed by the directors in conducting the business. About nine out of ten of the coöperatives surveyed had five members elected to the board of directors.

*Benefits derived by members.* Members of coöperative associations were asked about the advantages they derive from joining the association. The numerous answers gathered generally depended upon the attitude of the members toward the type of association to which they belonged. For

consumers' or retailers' coöperatives, members were of the opinion that the association promoted their economic welfare through legitimate business activities; they got quality goods at fair prices; they received patronage dividends at the end of the year; and they were afforded the means, or agency, to supply them with the things they needed. Other members, however, frowned upon their association and regretted their having joined it on the ground that in most cases the prices of goods at their store were higher than those prevailing in other stores (Chinese stores particularly), and that they could not get goods on account unlike in alien stores. This group of dissatisfied members also claimed that only the officers and directors of the association were benefited by the coöperative at the expense of the other members.

Members of producers' associations stated that they were afforded good market connections for their products through the intervention of their coöperative, that they found a ready buyer for their products who paid them reasonable prices, that they were able to use the warehouses and other facilities of the association which otherwise they could not have individually, and that they had marked improvement in their production and marketing methods through the educational program of their association. On the other hand, critics of producers' cooperatives contended that cooperative associations as a whole were operated for the benefit of a selected few, and that no benefits whatsoever could be derived from joining them.

Credit-coöperative members were afforded the wise use of credit at a very reasonable rate of interest and were encouraged to form the habit of thrift through saving a small amount regularly with their association.

*Causes of failure.* The failure of cooperatives in the Philippines is due to numerous causes, but primarily to inefficient management. Some coöperatives failed because the organizers lacked proper knowledge of the principles, objectives, and sound policies of the coöperative movement. Most coöperative associations that had ceased operating had insufficient working capital because of the difficulty of securing adequate credit facilities, of extravagant operating costs, and of very limited membership support to properly finance the project. Furthermore, the members were ill-advised as to what the association could and could not do, and they, therefore expected too much, even the impossible, from it. Such a condition broke down the morale of the members on account of the unsatisfactory results. Loss of contact with the members concerning the activities of their association broke down moral support, resulting in insufficient volume of business.

Sometimes loyal members were lacking, not because of the inability of the management to look after their welfare, but because of internal dissensions arising out of personal jealousies, selfish motives, and political or religious differences. Undue extension of credit to members, improper use of loans by borrowers from credit associations, strong competition from alien businessmen, and erroneous accounting procedures also contributed to failure. Inoperation might also have been caused by unforeseen or unavoidable circumstances, such as fires, floods, and adverse economic conditions, and by the general prejudice against coöperatives among the masses. A very important cause of failure observed was that associations were established even without any economic need for them in the locality.

## SUMMARY

1. There were 1,367 coöperative associations registered from 1946 to June 30, 1949, distributed into 975 consumers', 261 producers', 83 retailers' associations, 27 credit unions, 17 marketing, and 4 industrial coöperatives in all parts of the Philippines. About two thirds of the total number, or 961 associations, were inactive in 1949. Manila ranked first in total number of registered associations; Nueva Ecija, in number of producers' coöperatives; and Laguna, in number of credit unions.

2. The total membership was 260,134, or an average of 190 members in an association, ranging from 15 to 357.

3. The aggregate authorized capital of all registered coöperatives was ₱30,439,981, averaging ₱22,268 for each association, and ranging from ₱4,500 to ₱100,000. The paid-up capital was ₱3,398,213, or an average of ₱2,485 for an association. The average paid-up capital of each type of association was ₱3,572 for retailers', ₱2,735 for marketing coöperatives, ₱2,462 for producers', ₱2,219 for consumers', ₱1,106 for credit unions, and ₱1,000 for industrial coöperatives.

4. The value of the combined total assets of 54 different coöperative associations which submitted their financial and operating statements in 1949 was ₱1,547,067, averaging ₱28,649 for each association, and ranging from ₱684 to ₱412,326. Total liabilities, amounting to ₱499,276, or ₱9,245 for each association, were 32 per cent of the total equities. The total net worth, amounting to ₱1,047,790 for all associations and averaging ₱19,403 for each association, was 68 per cent of the total equities. Current assets represented 66 per cent; fixed assets, 32 per cent; and other assets, 2 per cent of the total assets. Current liabilities were equal to 30 per cent; fixed liabilities, 2 per cent; capital stock, 47 per cent; and surplus, 21 per cent of the total equities.

5. The amount of paid-up capital ranged from ₱142 to ₱160,772, averaging ₱13,504 for an association. Twenty-five per cent of all associations had paid-up and outstanding capital stock in excess of ₱8,000, and 30 per cent, less than ₱2,000.

6. On the basis of their net capital ratios, more than two thirds of all the associations had total liabilities less than 20 per cent of the total assets, including those associations having no liabilities, and 15 per cent, with more than 40 per cent of all assets. More than one half of the associations had current ratios of more than 5:1. The average members' equity was 67 centavos net worth for every peso of total assets, which was slightly higher than the desirable minimum of 50 to 60 centavos; the average surplus was 44 centavos for every peso of capital stock.

7. The total volume of sales for all coöperatives studied amounted to ₱4,666,622, or an average of ₱86,419 for each association. Gross profit, representing 19 per cent of total sales, averaged ₱16,118 for an association, and net profit, ₱3,757, equal to 4 per cent of the total volume of business. Operating expenses averaged 15 centavos for every peso of sales, with a tendency to increase with smaller volume of sales. Nine associations suffered losses at an average of ₱1,345 for the 1949 business year; 19 made a net profit below ₱1,000 at an average of ₱369 for each association, and 11, a net profit of more than ₱5,000, averaging ₱16,604 an association.

8. Seventy-four credit unions in operation as of October, 1949, had 2,077 loans made in the amount of ₱253,292, or an average of 27 loans each at ₱3,423 for each credit union.

9. The net savings of coöperative associations were distributed to members and nonmembers in the form of patronage refunds.

10. Coöperative associations were managed by members through an elected board of directors consisting of from five to eleven members, usually five, elected for a term of one year, which in turn appointed a manager who effected the policies prescribed by the board. Membership was drawn largely from the low-income groups.

11. Members derived many benefits, both economic and social, from their associations. Critics of coöperatives, however, claimed that only a selected few derived the most benefits.

12. The common causes of failure of coöperatives in the Philippines were lack of efficient management, insufficient capital and small volume of business due to disloyalty of members or to the difficulty in obtaining credit facilities, strong competition from aliens, and adverse economic and physical conditions beyond human control.

## LITERATURE CITED

- ARNALDO, M. V. 1931. A summary of the situation of the agricultural credit coöperative associations in the island of Panay. *Philippine Agriculturist* **19**: 531-540.
- BAKKEN, H. H., AND M. A. SCHAARS. 1937. *The economics of coöperative marketing*. 1st edition. v + 583 p. (p. 427). New York: McGraw-Hill Book Co., Inc.
- MABBUN, P. N. 1927. Study of the Tobacco Growers' Association, Inc. of Tuguegarao, Cagayan. *Philippine Agriculturist* **16**: 19-33.
- MABBUN, P. N. 1927. Progress of tobacco coöperative marketing in Cagayan. *Philippine Agriculturist* **16**: 341-350.
- MABBUN, P. N. 1929. The working of some rural coöperative credit associations in Cagayan and Isabela. *Philippine Agriculturist* **18**: 447-460.
- MABBUN, P. N. 1935. Coöperative marketing and our tobacco farmers. *Philippine Agriculturist* **24**: 451-463.
- MABBUN, P. N. 1937. Stabilizing our coöperative marketing associations. *Philippine Agriculturist* **26**: 312-326.
- POFFENBERGER, P. R., J. R. IVES, AND S. H. DEVALT. 1941. Status and trend of agricultural coöperation in Maryland. *Maryland Agric. Exper. Sta. Bull.* 441: 312.

## PUBLISHED CONTRIBUTIONS FROM THE COLLEGE OF AGRICULTURE: XIX<sup>1</sup>

L. B. UICHANCO  
*Dean, College of Agriculture*

The publication of *The Philippine Agriculturist* could not be resumed until two years after the liberation, when the first number of volume 31 was issued in July, 1947. The College started its first-semester classes on July 25, 1945, the first unit of the University to reopen its doors to students. The campus was then a mass of ruins and emptiness; there were no farm implements, laboratory equipment, work animals, library, and almost no pencil, paper, blackboard, and chalk. Most of the first few months were spent in cleaning up the mess and in getting work started. The handicaps were understandably very severe; the faculty members and students not only had to use makeshift tools and depend on memory to make up for the lack of references, but they also had to suffer frequent interruption in dodging enemy snipers, guarding against looters, and living in an atmosphere of general uncertainty because the war was still going on. The U. S. Armed Forces, which used the campus as a recreation camp, pre-empted most of the undestroyed buildings, crowding College activities further into very close quarters.

The most important asset which had been saved practically intact for the College from the last war was its faculty force. Had it not been for this fortunate circumstance, much time would have been lost in preparing a new and less experienced personnel who could not have produced so readily as effective results in rehabilitation. The faculty, together with the more advanced undergraduate students undertaking thesis work under their direction, thus managed to launch a research program with the minimum of delay. The reports have been mostly published in the College journal; a few, in outside publications.

The present contribution list covering the published papers from this College since the liberation cites 135 experiment station contributions and 67 general contributions. It should be noted that the last Experiment Station contribution number in the list is 1589, which represents the number of papers on original research produced from this College since its foundation in 1909. Because of the very wide range of agricultural subjects covered in these papers, they would appear casually as a crazy-quilt of titles on heterogeneous materials. However, taken as a whole, they fall into a unified pattern, with improvement of Philippine agriculture as the basic motif, each worker taking care of his special field and attempting to find the answers to a few questions here and there pertaining to his own line of work. Despite vigorous research activity, a great deal of the ground in agricultural knowledge in the Philippines is still unexplored, and it has been constantly the aim of the researcher to push further across the boundary of the unknown.

The past four volumes of *The Philippine Agriculturist* had to be issued as a quarterly publication, instead of the usual ten numbers to a

<sup>1</sup>General Contribution No. 850.

year's volume, as was the practice prior to the war. The cost of printing has continued to be high and the funds available for publication have always been small. Moreover, the supply of copy has not as yet been plentiful enough to warrant more frequent issues. With the implementation of the ECA aid, which, it is expected, is soon forthcoming, increased personnel and facilities will make possible a more intensive, as well as extensive, research activity. More agricultural problems of immediate practical application, as well of basic research, can then be attended to. It is hoped that more publication materials will result as more funds become available for printing.

## I. EXPERIMENT STATION CONTRIBUTIONS

1455. CENDAÑA, S. M., AND CLARE R. BALTAZAR. 1947. A biological study of *Empoasca flavescens* Fabricius (Cicadellidae, Homoptera). The Philippine Agriculturist 31: 1-22. Fig. 1-3.
1456. CAPINPIN, JOSÉ M., AND JESUS M. SISON. 1947. Heterosis in tomato. The Philippine Agriculturist 31: 23-33. Fig. 1-2.
1457. CALMA, VALERIANO C., AND HILARIO A. SAMONTE. 1947. Agronomic characters of (POJ 2878 X P.S.A. 14) F<sub>1</sub> sugar cane seedlings. The Philippine Agriculturist 31: 34-43. Fig. 1.
1458. SACAY, FRANCISCO M., AND MARTIN V. JARMIN. 1947. A study of economic and social conditions in a farm village of Laguna. The Philippine Agriculturist 31: 44-51.
1459. TABAYOYONG, FILOMENO T. 1947. The effects of the addition of copra meal to Los Baños clay loam. The Philippine Agriculturist 31: 52-59.
1460. GONZALEZ, LEON G., AND J. C. BUNOAN, JR. 1947. Variability of pili trees grown in the College of Agriculture. The Philippine Agriculturist 31: 60-65.
1461. VELARDE, MANUEL A. 1947. Correlation between weights and measurements of internal organs and dressed weights of carcasses of barrows. The Philippine Agriculturist 31: 66-72.
1462. PIZARRO, PRIMO I. 1947. Ipil-ipil (*Leucaena glauca* Linn.) seed meal in rations for growing chicks. The Philippine Agriculturist 31: 73-77.
1463. Banzon, Julian. 1947. Chemical basis for the conversion of coconut oil into hydrocarbons. The Philippine Agriculturist 31: 78-81.
1464. OCFEMIA, G. O., MARTIN S. CELINO, AND FELICIANO J. GARCIA. 1947. Further studies on transmission of bunchy-top and mosaic of abacá (Manila hemp plant), separation of the two diseases, and mechanics of inoculation by *Pentalonia nigronervosa* Coquerel. The Philippine Agriculturist 31: 87-97. Fig. 1-2.
1465. CAPINPIN, JOSÉ M., AND ENRIQUE G. LANTICAN. 1947. Morphological and physiological effects of de-awning on caryopsis of two bearded rice varieties. The Philippine Agriculturist 31: 98-108. Fig. 1-3.
1466. LUNA, CONSTANCE A. 1947. Breeding habits of sheep. The Philippine Agriculturist 31: 109-117.
1467. TOH, JIN SIONG. 1947. The use of rice seedlings in the determination of root-soluble phosphoric acid and potash in soils. The Philippine Agriculturist 31: 118-125.
1468. DIAZ, SIXTO E. 1947. Physiological studies on Philippine horses: I. Normal hemoglobin content, temperature, respiration rate, and pulse rate in the mare. The Philippine Agriculturist 31: 126-132.
1469. GONZALEZ, L. G., AND B. R. LUARDO. 1947. Introduced rambutan trees in the College of Agriculture and their propagation by inarching. The Philippine Agriculturist 31: 133-140. Fig. 1.
1470. AQUINO, DIONISIO I., AND L. I. ENGLE. 1947. Structure of certain soil types in the College of Agriculture. The Philippine Agriculturist 31: 141-146.
1471. ESGUERRA, JOSÉ P. 1947. Tapilan hay making. The Philippine Agriculturist 31: 147-150. Fig. 1.
1472. ESPINO, RAFAEL B. 1947. Eleven years' study on "Bunga ñg tubo": A résumé. The Philippine Agriculturist 31: 151-153.
1473. VILLARIBA, CESAR A., AND JOSÉ M. CAPINPIN. 1948. Morphogenetic effects of 2,4-dichlorophenoxyacetic acid on some crop plants. The Philippine Agriculturist 31: 163-176.
1474. DAVID, PEDRO A. 1948. Heterosis in *Datura* crosses. The Philippine Agriculturist 31: 177-184. Fig. 1.

1475. CAPINPIN, JOSÉ M., AND FELIX B. VILLAMAYOR. 1948. On clonal reproduction of rice. *The Philippine Agriculturist* **31**: 185-191. *Fig. 1-2*.
1476. ESGUERRA, JOSÉ P. 1948. Cost of producing Guinea grass, Napier grass, and Para grass for soiling in 1940-1943. *The Philippine Agriculturist* **31**: 192-198.
1477. DAWIS, VICENTE M., AND FEDERICO L. LABIS. 1948. The influence of different kinds of animal manure on the yield of the eggplant. *The Philippine Agriculturist* **31**: 199-205.
1478. OCFEMIA, RUFO H., AND VALERIANO C. CALMA. 1948. The performance of three varieties of rice when planted late in the season. *The Philippine Agriculturist* **31**: 206-211.
1479. TOLENTINO, LAMBERTO J. 1948. The fertility of Muscovy duck eggs. *The Philippine Agriculturist* **31**: 212-215.
1480. CALMA, VALERIANO C., AND SATURNINO G. RICO. 1948. Effects upon the yield of Ramai rice of ammonium sulfate, ammo-phos, and a home-mixed fertilizer. *The Philippine Agriculturist* **31**: 216-221.
1481. FRONDA, F. M., AND MELCHOR E. FRONDA. 1948. Distillery yeast, a possible feed for poultry. *The Philippine Agriculturist* **31**: 222-225.
1482. ESPINO, R. C., AND G. O. OCFEMIA. 1948. An additional insect vector of bunchy-top of abacá, or Manila hemp plant. *The Philippine Agriculturist* **31**: 231-232. *Fig. 1*.
1483. CAPINPIN, RENATO I., AND G. O. OCFEMIA. 1948. A study of weed eradication with 2,4-D in lawns, vacant lots, and pastures. *The Philippine Agriculturist* **31**: 239-255. *Fig. 1-3*.
1484. OÑATE, BURTON T., AND RAFAEL B. ESPINO. 1948. Effects of photoperiod upon the upland rice plant variety Inintiw. *The Philippine Agriculturist* **31**: 256-270. *Fig. 1*.
1485. REYES, FIDEL I. 1948. The growth and development of Philippine and Murrah carabaos and their crossbreed. *The Philippine Agriculturist* **31**: 271-278.
1486. BANZON, JULIAN. 1948. A photochemical reaction of some vegetable oils with chlorine gas. *The Philippine Agriculturist* **31**: 279-288. *Fig. 1*.
1487. BANZON, JULIAN, AND FELIX K. MARAMBA, JR., 1948. Studies on a photochemical reaction of coconut oil with chlorine gas. *The Philippine Agriculturist* **31**: 289-297.
1488. CALMA, VALERIANO C., AND MIGUEL D. PAGUIO. 1948. The performance of five varieties of lowland rice. *The Philippine Agriculturist* **31**: 298-304.
1489. SACAY, FRANCISCO M., CHAN MEESUKH, AND PRAVES SHRIBHIBHADHA. 1948. A comparative study of certain characteristics of first-year students in agricultural, rural, and academic high schools. *The Philippine Agriculturist* **31**: 305-310.
1490. FRONDA, F. M., AND PRECILLANO C. CAMPOS. 1948. Broodiness among Los Baños Cantonese layers. *The Philippine Agriculturist* **31**: 311-314.
1491. Uichanco, Luz A., AND JULIAN BANZON. 1948. Studies on ester transposition (ethanolysis) in coconut oil: reaction velocity and equilibrium constants. *The Philippine Agriculturist* **32**: 1-20. *Fig. 1-2*.
1492. DAVID, PEDRO A. 1948. Kenaf (*Hibiscus cannabinus* Linn.) culture in the College of Agriculture. *The Philippine Agriculturist* **32**: 21-30. *Fig. 1*.
1493. CAPINPIN, JOSÉ M., AND SATURNINO C. CAUTION. 1948. Study of Mendelian biotypes in the segregating generation of tomato hybrids. *The Philippine Agriculturist* **32**: 31-44.
1494. FRONDA, F. M., AND PACIFICO M. MARAJAS. 1948. Autosexed chicks from Los Baños Cantonese and Barred Plymouth Rock fowls. *The Philippine Agriculturist* **32**: 45-49.
1495. CALMA, VALERIANO C., AND NORBERTO C. PALIS. 1948. Inintiw and Sinariaya as secondary crops in succession to a primary rice crop. *The Philippine Agriculturist* **32**: 50-54.
1496. ARCIAGA, ANTONIO M., AND N. L. GALVEZ. 1948. The effect of soil reaction (pH) on the growth of pe-tsai plants and on their nitrogen, calcium, and phosphorus content. *The Philippine Agriculturist* **32**: 55-59.
1497. ESPINO, RAFAEL B. 1948. Effects of 2, 4-D on some common plants. *The Philippine Agriculturist* **32**: 60-64.
1498. RAMOS, FEDERICO V. 1948. Performance of Seraup Kechil 36 and Carreon rice varieties under upland conditions. *The Philippine Agriculturist* **32**: 65-70.
1499. ESGUERRA, JOSÉ P. 1948. Making corn-tapilan silage. *The Philippine Agriculturist* **32**: 71-78.
1500. ALFONSO, DOMINGO J., AND ALEJANDRO B. CATAMBAY. 1948. A study of the net duty of irrigation water for lowland rice in Calamba, Laguna. *The Philippine Agriculturist* **32**: 87-113. *Chart 1-7, fig. 1-6*.

1501. SACAY, FRANCISCO M., GIL F. SAGUIGUIT, AND FAUSTINO BRUAL. 1948. Educational and occupational pursuits of former students in the Batangas and Ilocos Norte high schools. *The Philippine Agriculturist* **32**: 114-123.
1502. CASTILLO, LEOPOLDO S. 1948. A study of the influence of two chick rations and two methods of brooding on the rate of growth and mortality of chicks. *The Philippine Agriculturist* **32**: 124-137.
1503. BONDOC, ENRIQUE O., AND JULIAN BANZON. 1948. Photochlorination of a homologous series of fatty acids from coconut oil. *The Philippine Agriculturist* **32**: 138-149. *Fig. 1.*
1504. CAPINPIN, JOSÉ M., AND RESTITUTO R. LOPEZ. 1948. Variability in plant and grain characters of Fortuna rice as influenced by methods of culture. *The Philippine Agriculturist* **32**: 150-164.
1505. FRONDA, F. M., AND PONCE BLAS H. INFANTE. 1948. Relation in ducks between duration of incubation and sex. *The Philippine Agriculturist* **32**: 165-172.
1506. CALMA, VALERIANO C., AND ANTONIO R. PIGA. 1948. Seraup Kechil 36 and Guinangang as primary crops in succession to a secondary rice crop. *The Philippine Agriculturist* **32**: 173-177.
1507. ANDRION, VICTORINO C. 1948. Effects of copra meal on certain chemical and biological properties of Los Baños clay loam. *The Philippine Agriculturist* **32**: 178-182.
1508. BELISARIO, MARIO C. 1949. A comparative study of four varieties of ramie. *The Philippine Agriculturist* **32**: 185-214. *Fig. 1-3.*
1509. CALMA, VALERIANO C., AND FRANCISCO S. ZAMORA. 1949. The yield and varietal characters of some varieties of the sweet potato. *The Philippine Agriculturist* **32**: 215-222.
1510. CAPINPIN, JOSÉ M., AND GREGORIO B. MIGUEL. 1949. Analytical studies of Rexoro, Nira, and Iola rice varieties grown in the College of Agriculture. *The Philippine Agriculturist* **32**: 223-230. *Fig. 1.*
1511. LAWAS, ORENCIO M., AND WILLIAM L. FERNANDEZ. 1949. A study of the transmission of corn mosaic and some of physical properties of its virus. *The Philippine Agriculturist* **32**: 231-238. *Fig. 1-3.*
1512. CARAÑGAL JR., APOLINARIO R., AND JULIAN BANZON. 1949. Studies on the solvent extraction of coconut oil with ethyl alcohol. *The Philippine Agriculturist* **32**: 239-251. *Fig. 1.*
1513. FAJARDO, PELAGIO S. 1949. The performance of three Federated Malay States rice compared with Raminad. *The Philippine Agriculturist* **32**: 252-256.
1514. FRONDA, FRANCISCO M., AND DOROTEO C. ASUNCION. 1949. Cow manure as a supplement to a ration for growing chicks. *The Philippine Agriculturist* **32**: 257-260.
1515. ROSARIO, LEODEGARIO J. DEL. 1949. Can male ducks be caponized for profit? *The Philippine Agriculturist* **32**: 261-264.
1516. UICHANCO, L. B. 1949. A method of mounting epiphytic orchids. *Philippine Orchid Review* **2** (No. 2): 16-17.
1517. JULIAN, JOSÉ B. 1949. Factors in the production of green ducks. *The Philippine Agriculturist* **32**: 267-275.
1518. CALMA, VALERIANO C., AND FEDERICO V. RAMOS. 1949. The culture of Guatemala grass, Guinea grass, Merker, and Napier for soilage. *The Philippine Agriculturist* **32**: 276-282.
1519. CENDAÑA, S. M. 1949. Treatment of structural bamboo with DDT as a preservative against powder-post beetles. *The Philippine Agriculturist* **32**: 283-290. *Fig. 1.*
1520. GALVEZ, N. L., AND PATRICIO Y. AGBAGALA. 1949. The effects on lowland soil as shown by rice of the application of copra meal. *The Philippine Agriculturist* **32**: 291-296. *Fig. 1-2.*
1521. RAMOS, FEDERICO V., AND VALERIANO C. CALMA. 1949. The production and selection of (P.B. 927  $\times$  POJ 2878) $F_1$  seedling canes. *The Philippine Agriculturist* **32**: 297-304.
1522. CAPINPIN, JOSÉ M., AND MAXIMINO C. REAÑO. 1949. Inducing morphological variations in crop plants with poisonous plant extracts. *The Philippine Agriculturist* **32**: 305-311. *Fig. 1-2.*
1523. SACAY, FRANCISCO M., NICOLAS C. CAMELLO, AND LUCIANO E. LACTAO. 1949. A prewar study of the availability of public school education to children in the barrios of Bay and Calauan, Laguna. *The Philippine Agriculturist* **32**: 312-317.
1524. CALMA, VALERIANO C., ILUMINADO G. VALENCIA, AND JESUS V. TALE. 1949. Effect of mass selection of the seed and of season of planting on the yield of the soybean. *The Philippine Agriculturist* **32**: 318-328. *Fig. 1.*

1525. BACLIG, JOSÉ B., AND F. M. FRONDA. 1949. A further study on the influence of ipil-ipil (*Leucaena glauca* Linn.) seed meal in a ration for growing chicks. The Philippine Agriculturist 32: 329-332.
1526. CAPINPIN, JOSÉ M., AND MANUEL A. ROA, JR. 1949. An extra-early yellow dwarf soybean. The Philippine Agriculturist 32: 333-338.
1527. FRONDA, F. M., LEODEGARIO J. DEL ROSARIO, AND LEOPOLDO S. CASTILLO. 1949. Sun porch for brooding chicks. The Philippine Agriculturist 32: 339-342.
1528. VIADO, GETULIO B., AND AVELINO E. BIGORNIA. 1949. A biological study of the Asiatic palm weevil, *Rhynchophorus ferrugineus* (Olivier), (Curculionidae, Coleoptera). The Philippine Agriculturist 33: 1-27. Pl. 1-2, fig. 1-4.
1529. MANUEL, AVELINO B. 1949. Observations on the range habits of growing chicks. The Philippine Agriculturist 33: 28-35.
1530. AGLIBUT, ANDRES P., AND PEDRO N. LAUDENCIA. 1949. A study of the effects of different amounts of water on surface and subsurface irrigation of lettuce. The Philippine Agriculturist 33: 36-50. Fig. 1-5.
1531. CAPINPIN, JOSÉ M., AND ROBERTO M. AMABA. 1949. Morphology and heredity of caryopsis characters in Inangel rice. The Philippine Agriculturist 33: 51-62. Fig. 1-4.
1532. PAULINO, LEONARDO A. 1949. Effects of varying lengths of illumination on the rate of growth and mortality of chicks. The Philippine Agriculturist 33: 63-71. Fig. 1.
1533. BUSTRILLOS, ANTONIO D., AND JULIAN BAZON. 1949. The equilibrium moisture of copra at various relative humidities. The Philippine Agriculturist 33: 77-87. Fig. 1-3.
1534. SACAY, FRANCISCO M., QUIRINO T. TAGORDA, AND GREGORIO B. FERNANDEZ. 1949. An economic and social study of tobacco farming in Isabela. The Philippine Agriculturist 33: 88-96.
1535. CALMA, VALERIANO C., AND SOLOMON G. CABRERA. 1949. A trial culture of alfalfa. The Philippine Agriculturist 33: 97-102.
1536. AGLIBUT, ANDRES P., AND APOLONIO V. LIPIO. 1949. A study of rural housing conditions of one hundred families in Angono, Rizal. The Philippine Agriculturist 33: 103-110.
1537. CABANILLA, CRISPIN E. 1949. The grazing capacity of pastures. The Philippine Agriculturist 33: 111-119. Fig. 1.
1538. ROLA, NENA A., AND N. L. GALVEZ. 1949. Effect of soil reaction on the growth of upland rice and on its nitrogen, calcium, phosphorus, and iron content. The Philippine Agriculturist 33: 120-125. Fig. 1.
1539. CAPINPIN, JOSÉ M., AND MARCIAL A. ALVIAR. 1949. Heterosis in the eggplant. The Philippine Agriculturist 33: 126-141. Fig. 1.
1540. OCFEMIA, G. O. 1949. The rapid dissemination of the mosaic disease of abacá, or Manila hemp plant (*Musa textilis* Née), in the field. The Philippine Agriculturist 33: 142-144.
1541. VER, REMBERTO Z. 1950. The growth and development of some pure breed and grade calves. The Philippine Agriculturist 33: 149-165.
1542. CAPINPIN, JOSÉ M., AND TEODOMERO M. YÑIGUEZ. 1950. Behavior of five Brazilian rice varieties under lowland culture in the College of Agriculture. The Philippine Agriculturist 33: 166-189.
1543. UICHANCO, L. B. 1949. A revision of the genus *Ectenus* Dallas, with description of a new species (Hemiptera, Pentatomidae). Philippine Journal of Science 78: 285-289.
1544. CALMA, VALERIANO C., AND FEDERICO V. RAMOS. 1950. An outstanding introduced variety of sugar cane. The Philippine Agriculturist 33: 190-196.
1545. CAMPOS, AMADO C. 1950. The use of sun porch for laying pullets. The Philippine Agriculturist 33: 197-202.
- 1546<sup>2</sup>. PALIS, GUILLERMO T., AND VALERIANO C. CALMA. 1948. Yields of broadcast and transplanted Seraup Kechil 36 rice. The Philippine Agriculturist 31: 226-230.
1547. VIADO, GETULIO B. 1950. Reproductive capacity of the Oriental migratory locust. The Philippine Agriculturist 33: 221-238. Pl. 1-2, fig. 1.
1548. DAVID, PEDRO A. 1950. Vanilla culture in the College of Agriculture at Los Baños. The Philippine Agriculturist 33: 239-249. Fig. 1-4.
1549. RAMOS, FRANCISCO T. 1950. A comparative study of two rations for growing chicks. The Philippine Agriculturist 33: 250-256.
1550. MENDOZA, TEOFILO M. 1950. The floor-space requirements of broilers. The Philippine Agriculturist 33: 257-262.

<sup>2</sup>Published as Experiment Station contribution No. 1482 by mistake.

1551. CAPINPIN, JOSÉ M., AND TEODORO A. IRABAGON. A genetic study of pod and seed characters in *Vigna*. The Philippine Agriculturist 33: 263-277.
1552. GONZALEZ, LEON G., AND CARLOS R. CASAL. 1950. Topworking pummelo trees by graftinarching. The Philippine Agriculturist 33: 278-284. Fig. 1.
1553. OCFEMIA G. O., AND SILVESTRE V. JAVIER, Jr. 1950. Experimental control of water hyacinth in lowland rice fields. The Philippine Agriculturist 33: 285-287. Fig. 1.
1554. SACAY, FRANCISCO M., JAINARI S. KIBTIANI, AND MAJINDI K. ANUDDIN. 1950. A survey of economic and social conditions of farmers in Sulu. The Philippine Agriculturist 34: 1-9.
1555. CAPINPIN, JOSÉ M., AND ROBERTO F. CRUZ. 1950. Effects of inbreeding Lagkit corn. The Philippine Agriculturist 34: 10-20.
1556. GONZALEZ, LEON G., AND FLORANTE CRUZ SALVADOR. 1950. Inter-generic graft affinity of the lanzones, *Lansium domesticum* Correa. The Philippine Agriculturist 34: 21-25.
1557. SANDOVAL, MARIANO A. 1950. Growth and maturity of the first-generation progeny of the New Hampshire and S. C. White Leghorn chickens imported from the United States. The Philippine Agriculturist 34: 26-33.
1558. AGLIBUT, ANDRES P., AND SILVERIO P. VILLA. 1950. Rural housing conditions of one hundred families in Malaking Pulo, Tanauan, Batangas. The Philippine Agriculturist 34: 34-41.
1559. CALMA, VALERIANO C., FRANCISCO C. REYES, AND MARCOS DE LA CRUZ. 1950. Tests of selected strains of Elon-elon and Guinangang. The Philippine Agriculturist 34: 42-45.
1560. ALCAIDE, ALEJANDRO R. 1950. Pulse rate, respiration, and body temperature of native cattle. The Philippine Agriculturist 34: 46-48.
1561. MONDOÑEDO, JOSÉ R. 1950. Production of broilers from New Hampshire, Los Baños Cantonese, and Single Comb White Leghorn breeds of poultry. The Philippine Agriculturist 34: 49-53.
1562. DAVID, PEDRO A. 1950. Canton and pacol, two promising sources of pulp for the manufacture of kraft paper and newsprint in the Philippines. The Philippine Agriculturist 34: 54-58.
1563. DAVID, PEDRO A. 1950. A progress report on decortication and degumming of ramie, *Boehmeria nivea* (Linn.) Gaudich. The Philippine Agriculturist 34: 59-60.
1564. CAPINPIN, JOSÉ M., AND JOSÉ L. BERENGUER. 1950. A cytogenetic study of parthenocarpy in eggplant resulting from interspecific pollination. The Philippine Agriculturist 34: 65-77. Fig. 1-3.
1565. DE LA TORRE, QUINTIN L., N. B. TABLANTE, AND F. M. FRONDA. 1950. Consumers' preferences in the city of Manila for poultry and poultry products. The Philippine Agriculturist 34: 78-83.
1566. CALMA, VALERIANO C., AND EDUARDO S. PANINGBATAN. 1950. Field test of six varieties of sweet potato. The Philippine Agriculturist 34: 84-89.
1567. ALFONSO, PABLO J., JR. 1950. "Manamar" as a protein supplement in rations for growing chicks. The Philippine Agriculturist 34: 90-95.
1568. ARNALDO, MARCIA R., AND JOSÉ M. CAPINPIN. 1950. Artificial pollination and seedling production in begonia. The Philippine Agriculturist 34: 96-109. Fig 1-2.
1569. DINAYAN, ALFONSO B., AND F. M. FRONDA. 1950. A comparative study of the influence of the leaves and young shoots of Centrosema, ipil-ipil, and sweet potato as green feed on the growth of chicks. The Philippine Agriculturist 34: 110-115.
1570. CALMA, VALERIANO C., AND DIMAS L. CASTRO. 1950. The effect of time of applying ammonium sulfate on the yield of corn. The Philippine Agriculturist 34: 116-120.
1571. SANTOS, F. O. 1947. Food utilization. Special Report. Philippine Committee, Food and Agriculture Organization of the United Nations: 23-28.
1572. JULIANO, JORGE P. 1951. A study of the mosaic disease of abacá, or Manila hemp plant (*Musa textilis* Née), with special reference to sources of inoculum and possible transmission of the virus by mechanical means. The Philippine Agriculturist 34: 125-132.
1573. GUTIERREZ, JOSÉ S. 1951. Studies on the continuous extraction of coconut oil with the use of ethyl alcohol. The Philippine Agriculturist 34: 133-143. Fig. 1-5.
1574. AGLIBUT, ANDRES P., N. L. GALVEZ, AND RAYMUNDO E. JOVELLANOS. 1951. The influence of rainfall and cultural practices on soil erosion and surface runoff. The Philippine Agriculturist 34: 144-154. Fig. 1-3.
1575. QUIBIN, CRISPULO. 1951. The capacity of native steers for plowing. The Philippine Agriculturist 34: 155-162.

1576. JONGO, EUGENIO A. 1951. Effects of extra night feeding on the rate of growth of male ducklings. *The Philippine Agriculturist* **34**: 163-168.
1577. CALMA, VALERIANO C., AND ROMEO P. MARTINEZ. 1951. The influence upon the yield of sweet corn of the number of plants in a hill. *The Philippine Agriculturist* **34**: 169-173.
1578. SANTOS, ALMARIO C. DE LOS. 1951. Water-treated copra meal as a protein supplement in a ration for growing chicks. *The Philippine Agriculturist* **34**: 174-177.
1579. GALVEZ, N. L., AND GABRIEL V. AQUINO. 1951. The base-exchange capacity of some upland and lowland soils. *The Philippine Agriculturist* **34**: 178-186.
1580. DERICO, TAUTI R. 1951. Experimental control of cogon (*Imperata cylindrica* [Linn.] Beauv.), water hyacinth (*Eichornia azurea* Kunth.), *Lantana camara* Linn., and other noxious weeds with 2, 4-D and other herbicides. *The Philippine Agriculturist* **34**: 189-201. *Fig. 1-7*.
1581. VIADO, GETULIO B. 1951. Reproductive capacity of the common tomato lady beetle. *The Philippine Agriculturist* **34**: 202-212. *Pl. I*.
1582. FRONDA, ROBERTO E. 1951. The influence of artificial illumination on the egg production of New Hampshire yearling hens. *The Philippine Agriculturist* **34**: 213-218.
1583. CAPINPIN, JOSÉ M., AND ALFREDO B. MAGNAYE. 1951. Hybridization of cultivated and wild rice. *The Philippine Agriculturist* **34**: 219-229. *Fig. 1*.
1584. GALEON, FELIPE C. 1951. The growth and habits of kids of Philippine goats. *The Philippine Agriculturist* **34**: 230-235.
1585. LIOANAG, ADOLFO M. 1951. Copra meal in a ration for growing ducklings. *The Philippine Agriculturist* **34**: 236-239.
1586. CABANTAC, DEMETRIO M. 1951. The growth and activities of sucking calves. *The Philippine Agriculturist* **34**: 240-242.
1587. FERNANDEZ, WILLIAM L. 1950. Raising lambs artificially. *Philippine Jour. Animal Ind.* **II**: 57-62.
1588. REDUQUE, JACINTO M. 1950. The horses found in Los Baños, Calamba, and Cabuyao, Laguna. *Jour. Animal Ind.* **II**: 35-42.
1589. TABLANTE, N. B., AND O. G. SANTOS. 1951. Organization and operation of coöperatives in the Philippines. *The Philippine Agriculturist* **34**: 243-251.

## II. GENERAL CONTRIBUTIONS

786. FRONDA, F. M. 1948. A review: Poultry production. *The Philippine Agriculturist* **31**: 233-234.
787. VILLEGAS, VALENTE. 1948. The recent importation of livestock from Pakistan. *The Philippine Agriculturist* **32**: 79-81.
788. FRONDA, F. M. 1948. A review: Successful poultry management. *The Philippine Agriculturist* **32**: 82-83.
789. UICHANCO, L. B. 1948. The past and present of biological research in the Philippines. *Jour. Philippine Pharmaceutical Assoc.* **35**: (11): 497-504.
790. UICHANCO, L. B. 1948. How agricultural research is conducted and reported on. University of the Philippines Faculty Conference, 1948: Papers and Proceedings. 1-103 p. 75-84.
791. UICHANCO, LEOPOLDO BANCAIN. 1949. (Winter). Annual report (of the College of Agriculture for the academic year ending June 4, 1946). *The Pacific Spectator* (Stanford) **3**: 4-23.
792. GALVEZ, N. L. 1949. A review: Chemicals, humus, and the soil. *The Philippine Agriculturist* **32**: 343-344.
793. SACAY, FRANCISCO M. 1950. The food supply and population of the Philippines. *The Philippine Agriculturist* **33**: 203-217.
794. UICHANCO, LEOPOLDO B. 1949. Doro and the magic medal. *Philippine Folklore coll.* by Lucetta K. Ratcliff. *Jour. American Folklore*, July-September, 1949: 269-270.
795. VILLEGAS, VALENTE, AND CIPRIANO A. FLORES. The fresh meat supply in the City of Baguio. *The Philippine Agriculturist* **33**: 288-294. *Fig. 1*.
796. UICHANCO, L. B. 1950. Problems of scientific work in the Philippines. *Forestry Leaves*, Vol. IV, No. 2, p. 1-4, August, 1950.
797. FRONDA, F. M. 1950. You, too, can own a chicken farm. *Agricultural and Industrial Life* **12** (April): 18, 30.
798. FRONDA, F. M. 1950. Our poultry feed problem. *Agricultural and Industrial Life* **12** (August): 17, 40.

799. FRONDA, F. M. 1950. An all-mash ration for caged layers. *Agricultural and Industrial Life* **12**: (September): 4, 43.
800. FRONDA, F. M. 1950. Is there money in poultry raising? *Poultry Messenger* **1** (September): 4.
801. CAMPOS, AMADO C., AND F. M. FRONDA. 1950. Hormonized roosters for Christmas. *Agricultural and Industrial Life* **12** (October): 30, 36.
802. FRONDA, F. M., AND ALBINO P. VARONA. 1950. Raise chickens for profit. *Agricultural and Industrial Life* **12** (November): 3, 21.
803. FRONDA, F. M. 1951. Water and your chickens. *Agricultural and Industrial Life* **13** (2): 6.
804. VILLEGAS, VALENTE. 1947. Our animal industries: cattle production. *Agricultural-Commercial-Industrial Life* **9**: 14, 15, 35.
805. VILLEGAS, VALENTE. 1947. Our animal industries: carabao and horse production. *Agricultural-Commercial-Industrial Life* **9**: 8, 9, 37.
806. VILLEGAS, VALENTE. 1948. Our animal industries: dairy production. *Agricultural-Commercial-Industrial Life* **10**: 6, 7, 35.
807. VILLEGAS, VALENTE. 1948. Our animal industries: goat and sheep production. *Agricultural-Commercial-Industrial Life* **10**: 8, 33.
808. VILLEGAS, VALENTE. 1948. Carabaos. *Manila Times Magazine*. Vol. III, No. 252. (August 25) 22-23.
809. VILLEGAS, VALENTE. 1948. Fresh milk on your doorstep. *The Evening News, Saturday Magazine*, Vol. III, Nos. 34, and 38.
810. VILLEGAS, VALENTE. 1948. Our post-war livestock industry. *Agricultural-Commercial-Industrial Life* **10** (11): 2, 3, 33.
811. VILLEGAS, VALENTE. 1948. Our horse industry fights for survival. *Agricultural-Commercial-Industrial Life* **10** (12): 14.
812. VILLEGAS, VALENTE. 1949. Marketing livestock by live weight. *Agricultural-Commercial-Industrial Life* **11** (7): 17, 20.
813. VILLEGAS, VALENTE. 1949. Our meat supply. *The Manila Times Mid-week Review*: 7.
814. VILLEGAS, VALENTE. 1949. Suggestions for naming farm animals. *Agricultural-Commercial-Industrial Life* **11** (11): 4, 19.
815. VILLEGAS, VALENTE. 1950. Castrating farm animals. *Agricultural and Industrial Life* **12** (1): 12.
816. VILLEGAS, VALENTE. 1950. The breeding habits of sheep and goats. *Agricultural and Industrial Life* **12** (3): 22.
817. VILLEGAS, VALENTE. 1950. Forage plants - Animal feed. *Agricultural and Industrial Life* **12** (4): 15 and 24.
818. VILLEGAS, VALENTE. 1950. How to tell the age of cattle. *Agricultural and Industrial Life* **12** (8): 13, 31.
819. VILLEGAS, VALENTE. 1950. Common ailments of sheep and goats. *Agricultural and Industrial Life* **12** (9): 12-13.
820. VILLEGAS, VALENTE. 1950. Silo and silage. *Agricultural and Industrial Life* **12** (11): 15.
821. VILLEGAS, VALENTE. 1950. Manure of farm animals. *Jour. Soil Science Soc. Philippines* **3** (12): 181-183.
822. CATAMBAY, ALEJANDRO B. 1950. Mechanized corn culture. *Philippine Agric. Engin. Jour.* **1**: 17-19, 23, 36, 38.
823. GALVEZ, N. L. 1949. The dirt under our feet. *Laguna Academy Commencement Number*, April, 1949.
824. VIADO, G. B. 1948. How to make an insect collection. *Philippine Scouting* **7** (3): 4, 5, 14, 16. *With figures.*
825. VIADO, G. B. 1949. DDT and bamboo-craft. *Agricultural-Commercial-Industrial Life* **11** (4): 4.
826. VIADO, G. B. 1949. Rat control and the new rodenticides. *Agricultural-Commercial-Industrial Life* **11** (6): 2, 3.
827. VIADO, G. B. 1949. The new insecticides: I. Benzene hexachloride, chlordane, and hexaethyl tetraphosphate. *Agricultural-Commercial-Industrial Life* **11** (10): 22, 23.
828. VIADO, G. B. 1949. The new insecticides: II. Parathion, toxaphene, dichloropropane-dichloropropene, and ethylene dibromide solution. *Agricultural-Commercial-Industrial Life* **11** (12): 18, 31, 34.
829. VIADO, G. B. 1950. DDT can be a hazard. *Agricultural and Industrial Life* **12** (1): 14, 15.

830. VIADO, G. B. 1950. The new insecticides: III. Aldrin, dieldrin, and allethrin. *Agricultural and Industrial Life* 12 (9): 5, 29.
831. VIADO, G. B. 1950. Termite control. *Agricultural and Industrial Life* 12 (10): 3, 39.
832. VIADO, G. B. 1950. Control of land snails and slugs. *Agricultural and Industrial Life* 12 (11): 4, 5, 37.
833. TABLANTE, N. B. 1948. Labor requirements for potatoes. *Farm Economics*, September, 1948. No. 162, p. 4220.
834. TABLANTE, N. B. 1948. Coöperation and the farmer. *Aggie Green and Gold*, October.
835. TABLANTE, N. B. 1948. An Aggie Abroad: Recollections. (A poem). *Aggie Green and Gold*, October.
836. TABLANTE, N. B. 1948. The cost of producing potatoes. *Farm Economics*, November, 1948. No. 164. p. 4234-4235.
837. TABLANTE, N. B. 1949. The withered rose. (A poem). *Aggie Green and Gold*, November, 1949.
838. TABLANTE, N. B. 1950. Primer on our tenancy laws. *Agricultural and Industrial Life* 12: 4. p. 19, 28, 31, 33.
839. TABLANTE, N. B. 1950. Farm labor can be productive. *Agricultural and Industrial Life* 12: 7. p. 24, 42.
840. TABLANTE, N. B. 1950. "Welga!" (A short story). *Agricultural and Industrial Life* 12 (8): p. 10, 11, 36, 37.
841. TABLANTE, N. B. 1950. Retail outlets for the farmers' products. *Agricultural and Industrial Life* 12 (10): p. 20-21.
842. TABLANTE, N. B. 1950. Legal phases of coöperative associations. *Agricultural and Industrial Life* 12 (11): p. 13, 37.
843. TABLANTE, N. B. 1950. Are you going to farm? *Agricultural and Industrial Life* 12 (12): p. 2-3, 40-41.
844. TABLANTE, N. B. 1950. A tale of two feathered ladies. (A short story). *Agricultural and Industrial Life* 12 (12): p. 16-17.
845. TABLANTE, N. B. 1951. Found! (A short story). *Agricultural and Industrial Life* 13 (1): p. 10-11, 20-21.
846. SANTOS, F. O. 1949. The International Rice Commission Conference, Bangkok, Siam. *Nutrition News*, Vol. 2, No. 4.
847. SANTOS, F. O. 1949. The future of nutrition work in the Philippines. *Nutrition News*, Vol. 2, No. 5.
848. SANTOS, F. O. 1949. Some research problems in nutrition in the Philippines. *Nutrition News*, Vol. 2, No. 6.
849. SANTOS, F. O. 1950. The U. P. grading system. University of the Philippines, Faculty Conference, 1949. *Papers and Proceedings*, 1-118 p. (35-44).
850. UICHANCO, L. B. 1951. Published contributions from the College of Agriculture: XIX. *The Philippine Agriculturist* 34: 252-260.
851. AGLIBUT, A. P., F. M. FRONDA, AND T. M. MENDOZA. 1951. Floor space requirements of broilers raised in battery cages. *Philippine Agric. Engin. Jour.* 2: 21-22.
852. SARAO, FELIX B. 1951. Los Baños Y.M.C.A. banana garden helped tide people over hunger during war. *Philippines' Young Men* 11 (10): 7.

## COLLEGE AND ALUMNI NOTES

The inauguration of Col. Jasper Ewing Memorial Boys' Camp was held on March 17, 1951, with President B. M. Gonzalez as guest of honor. The inaugural program was held under the auspices of the committee of management, Los Baños YMCA. Among those who also took part in the ceremonies were Dean and Mrs. L. B. Uichanco, Dean Florencio Tamesis, Professor and Mrs. Eugenio de la Cruz, and Dr. F. O. Santos, chairman of the committee on management.

A regular scientific meeting of the Los Baños Biological Club was held on March 30, 1951. The following paper was read and discussed: "The effect of applying ammonium sulfate at different times on the yield of corn." by Dr. V. C. Calma and Mr. D. L. Castro, of the Department of Agronomy.

The Department of Physical Education of the Colleges of Agriculture and Forestry held its annual lettermen day on March 20, 1951. Professor Eugenio de la Cruz, the guest of honor, awarded the trophy cup to the Freshmen Aggies for having won the intramural general championship. Dean L. B. Uichanco awarded the pennants to the champion teams in various ball games, and medals to Francisco Milan. Professor A. B. Cambay awarded the letters. The award ceremonies were preceded by a mass folk dance, calisthenics, and gymnastics. Mr. G. S. Gascon was in charge of physical education in both colleges. He was assisted by Miss Luwalhati D. Yñiguez.

The College Freshman class staged a night rally on March 10, 1951, under the direction of the adviser, Dr. S. M. Cendaña. Highlight of the affair was the burning of the Freshies' skullcaps in the bonfire. The following received special awards: Jesus M. Consunji for leadership, Edilberto A. Uichanco for loyalty, and Marcos Vega, Ricardo Lantican, and Orlando Sacay for scholarship.

The College inter-class oratorical contest was held on March 9, 1951, under the auspices of the Student Body Organization, of which Quirino Villaviza is the President. The winners were Rodolfo Ylarde, Manuel Iñigo, Salome del Rosario, and John Taylor.

Dr. Deogracias V. Villadolid, '19, director of the Bureau of Fisheries, spoke on fish production and utilization at the nutrition conference, held under the auspices of the Philippine Association of Nutrition on March 10, 1951.

Mr. Francisco D. Marquez, '15, administrative officer of the Department of Agriculture and Natural Resources, spoke on the production of fruits and vegetables.

Among those who led the discussions following the reading of the papers were: Dr. Valente Villegas, '13, on the production of meat, poultry, and eggs; Mr. Jose Saddul, '32, on the production of fruits and vegetables; and Dr. Francisco M. Sacay, '25, on rice production.

Dean L. B. Uichanco, '15, spoke on the rôle of science in agriculture on March 11, 1951, at the Araneta Institute of Agriculture in connection with its celebration of the Fifth Foundation Day Anniversary.

Dr. Canuto G. Manuel, '24, ornithologist and chief of the division of zoology of the National Museum, has been awarded a UNESCO fellowship on museography in North America. He will observe American museums and zoological parks in the United States.

Professors A. B. Catambay, '24, V. C. Calma, '26, and F. M. Sacay, '25, have been authorized by the University authorities to make trips and give advice to the LASEDECO regarding its settlement experiment in Bukidnon.

Dr. F. M. Sacay, '25, delivered the commencement address at the closing exercises of the Santa Rosa High School in Laguna on March 30, 1951.

Dr. Leon G. Gonzalez, head of the Department of Agronomy, was elected chairman and Professor Calixto Mabesa, secretary of the section of horticulture, National Research Council of the Philippines, at a meeting held on the campus on April 3, 1951.

Dr. V. C. Calma, of the Department of Agronomy, left for Cotabato on April 20, 1951, to observe the crops of the LASEDECO.

The College faculty, employees, and students donated 75 liters of blood to the Red Cross Blood Bank in March, 1951. The move to give this valuable donation was initiated by Dr. Antonio G. Tan, of the College Infirmary, and the Maquiling Ladies' Club, of which Mrs. Mercedes A. Uichanco is the president.

The 20th commencement exercises of the U. P. Rural High School was held on April 7, 1951, with President B. M. Gonzalez as the commencement speaker. Rodolfo M. Ela and Aurora E. Fronda were the valedictorians in the boys' and girls' curricula, respectively. The salutatorians were Edwin F. Fabregar and Adela G. Santos. The graduating class was composed of 23 boys and 12 girls.

After the graduation exercises, President and Mrs. B. M. Gonzalez were honored with a luncheon by the faculties and employees of the Colleges of Agriculture and Forestry.

The closing exercises of the Maquiling School was held on April 21, 1951. Dean L. B. Uichanco, president of the Board of Trustees, distributed certificates to 53 new graduates.

Classes in the summer institute for agricultural teachers began on May 2, 1951. The following courses were offered to promote the professional improvement of teachers of agriculture: Poultry Raising, Swine Raising, Cattle and Carabao Production, Cereals and other Annual Crops, Floriculture and Ground Improvement, Propagation of Tropical Fruit Plants, Vegetable Gardening, Perennial and Industrial Crops, Introduction to Education, Educational Psychology, and Methods of Teaching Vocational Agriculture.

Dr. Bienvenido M. Gonzalez, '13, president of the University for 12 years, retired from the institution after nearly four decades of service. President Quirino paid him tribute for his splendid service, saying: "For 37 years Dr. Gonzalez has served the U. P. in various capacities with honesty, integrity, strength of character, and amazing capacity for hard work."

Mr. Demetrio Santos, '36, was recently sworn into office as the new import control commissioner by President Quirino. Mr. Santos has served

for some years in various boards of government and private corporations. He is at present president of the Philippine Association of Agriculturists.

Several alumni read papers and took part in the discussion at the agricultural engineering convention, which was held in Manila, on March 30-31, 1951. They were Doctors F. M. Fronda '19, Gonzalo Merino, '14, Alexander Gordon, '23, and Anastasio Teodoro, '18, and Messrs. Abelardo Baelig, '46 and Julian Bulanadi, '35. Professor Andres P. Aglibut, of the Department of Agricultural Engineering, also read a paper at the convention. The convention was sponsored by the Philippine Society of Agricultural Engineers, of which Professor A. B. Catambay, '24, is the president.

Mr. Quirino T. Tagorda, '48, a former member of the College faculty, is assistant director of the Fatima High School in San Mateo, Isabela. The Director, an American Father, was so impressed with the performance of Mr. Tagorda that "he would not hesitate taking in another graduate who majored in agricultural education."

At a meeting on April 5, 1951, the College faculty approved to recommend the graduation of 39 candidates. The new graduates were as follows: (for B. S. Agr.) Dolan T. Albas, Rosario A. Aspiras, Gloria C. Bandong, Carlos G. Benavidez, Pablo M. Bueno, Tomas T. Cabanit, Alberto B. Dalañgin, Jorge G. Davide, Tauti R. Derico, Severino C. Diloy, Isidro S. Domingo, Blas G. Dukil, Manuel C. Esguerra, Blas A. Gaac, Benjamin Q. Gana, Amado C. Garcia, Bienvenido V. Garcia, Andres D. Goseco, Jr., Manuel C. Inigo, Primo V. Jarmin, Teodoro A. de Jauregui, Jorge P. Julianio (*cum laude*), Manuel S. Mallorca, Rafael A. Martelino, Roman C. Niedao, Rosalinda P. Novero, Wilfrido P. Novera, Juanito G. Odejar, Flaviano R. Pagador, Antonio C. Pizarro, Vivencio D. Rodriguez, Efren B. Sibayan, Valentina B. Silva, So Pui Fong, Rufino M. Sojetado, Frank L. Taclay, Eduardo E. Tirona, Levy A. Trinidad, and Nestor C. Vera Cruz; (for A. A.) Celso G. Gonzales, Eleuterio C. Rebancos, Aguinaldo G. de los Reyes, and Leonardo B. Silva.

Dr. Rafael B. Espino, professor and head of the Department of Agricultural Botany, died on May 18, 1951, at the University of Santo Tomas Hospital in Manila. He had served the College since his graduation in 1915. Dr. José M. Capinpin has been appointed acting head of the department.

A two-week orientation course for agricultural extension workers was held at the College in May, 1951, with Dr. F. M. Sacay and Mr. F. G. Galang as co-chairmen. At the closing program the following were guest speakers: Dr. Jack Y. Bryan, of the American Embassy; Dean L. B. Uichanco of the College of Agriculture; Director Gonzalo Merino of the Bureau of Plant Industry; and Mr. John V. Hepler, adviser in the Department of Agriculture and Natural Resources.

At a meeting of the Society of Agricultural Engineers, the following alumni were elected officers: A. B. Catambay, '24, president; E. L. Rigor, '36, secretary-treasurer; and S. Capistrano, '15, director.

The following alumni, who are with the Armed Forces of the Philippines, were given the permanent rank of lieutenant-colonel; Jacinto B. Leoncio, '30, Flaviano P. Olivares, '36, and Conrado B. Uichanco, '33.

Mr. Isidro S. Macaspac, '39, a civilian employee of the U. S. Army at Fort Stotsenberg, has been sent to the United States to make a study of labor conditions and wage standardization. He was formerly with the Department of Plant Pathology of the College.

Mr. Jorge P. Juliano, '51, was one of the two Filipino delegates who participated in the International Work Camp conference for South East Asia, which was held for one month near Chiengrai in northern Thailand. He returned on May 10, 1951. Mr. Juliano is at present an instructor in Silliman University.

## THE EXPERIMENT STATION

---

### LIST OF AVAILABLE PUBLICATIONS

#### Circulars:

- No. 2.—Bud Rot of Coconut..... *By G. O. Ocfemia*  
No. 8.—Horse Breeding in the Philippines..... *By V. Villegas*  
No. 11.—The New College Copra Drier—(Revised).... *By Moises M. Kalaw*  
No. 17.—College Trapnest..... *By F. M. Fronda and P. S. Paje*  
No. 18.—Surveying for Area with a Surveyor's  
Staff..... *By Alexander Gordon*  
No. 23.—Curing Pork and Making Sausage for  
Home Use..... *By Mariano Mondoñedo*  
No. 24.—Construction and Operation of Silos in the  
College of Agriculture..... *By J. P. Esguerra*  
No. 28.—Cotton Culture..... *By Eulalio P. Ballazar*  
No. 29.—Collegiate Education in Agriculture..... *By Leopoldo B. Uichanco*  
No. 30.—What Should Filipino Ornamental Gardens  
and Ornamental Plants Be?..... *By N. B. Mendiola*

The price of the circulars listed above is thirty centavos (₱0.30) each.

All orders with payment should be addressed to the Business Manager,  
THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

---

PHILIPPINE AGRICULTURE, Volume 1	{ Cloth bound .....	₱10.00
	{ Paper bound .....	8.00
	{ Postage.....	0.25

---

A MANUAL OF PLANT BREEDING FOR THE TROPICS ..... ₱6.00

ALL ORDERS WITH REMITTANCE SHOULD BE ADDRESSED TO:  
THE DEAN  
COLLEGE OF AGRICULTURE  
COLLEGE, LAGUNA, PHILIPPINES

# The Philippine Agriculturist

(Formerly The Philippine Agriculturist and Forester)

*Published by the* COLLEGE OF AGRICULTURE  
UNIVERSITY OF THE PHILIPPINES

Vol. 1—2	Vol. XVIII—complete
Vol. III—9-10	Vol. XIX—complete
Vol. IV—3, 5-6, 7	Vol. XX—complete
Vol. V—2, 3, 5, 6, 7, 8, 9, 10	Vol. XXI—complete
Vol. VI—complete	Vol. XXII—complete
Vol. VII—complete	Vol. XXIII—complete
Vol. VIII—3, 4, 5, 6, 7, 8-9, 10	Vol. XXIV—complete
Vol. IX—3, 4-5, 8-9	Vol. XXV—complete
Vol. XI—3, 4, 5, 6, 7, 8	Vol. XXVI—complete
Vol. XIII—1, 3, 4, 5, 6, 8, 10	Vol. XXVII—complete
Vol. XIV—complete	Vols. XXVIII, XXIX and XXX—burned
Vol. XV—complete	Vols. XXXI, XXXII, XXXIII and XXXIV—complete
Vol. XVI—complete	
Vol. XVII—6, 7, 8, 9, 10	

Back copies (Vols. I to XXVII) sell at 50 centavos.

Consolidated index (Vols. I to XX) 50 centavos excluding postage.

Send your order to the BUSINESS MANAGER, THE PHILIPPINE  
AGRICULTURIST, COLLEGE, LAGUNA, PHILIPPINES.